

***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***

***14<sup>th</sup> – 18<sup>th</sup> September 2020***

***For the  
International Cyanide Management Code***



**Name of Operation:** Harmony One Plant

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

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

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**Location and General Description of the 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. The 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 The ore is rapidly withdrawn from the apex of the cone via a shuttle belt feed conveyor feeding onto a main silo feed conveyor.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 (Run Of Mine) 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, utilising 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 Calcium Oxide (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 (grams per ton).

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 on-line 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 (Carbon in Pulp):**

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 screen, and is pumped to the residue Pachuca (tank). The slurry from the residue Pachuca is then sampled by an automatic on-line WAD (Weak Acid Dissociable) cyanide analyser. The majority of residue is pumped to the slimes dams (TSFs), 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 a 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 (Anglo American Research Laboratories) process is used at 130°C and 450 kpa. All three elution modules are controlled by means of a PLC (Programmable Logic Controller), which makes the entire process automatic. The four oil heaters (a.k.a. Themopacs) that are 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 the smelt house. This is where the gold in solution is recovered by zinc precipitation rather than the usual electro-winning process.

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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.

### **Tailings**

Residue tailings is pumped from the plant using a 450mm diameter mortar-lined pipeline. The main pipeline leaves the plant where it reaches the split valves. These valves give the plant the ability to split the stream to one of two Tailings Storage Facilities (TSFs). The FSS8 West and East TSF complex is the biggest facility the plant deposits on with a total capacity of 320 000 t/m. The second TSF at the plant's disposal is the FSS2 facility with a capacity of 160 000 t/m. The combined capacity of the two TSFs is 480 000 t/m, which is well above the plants design capacity; thus, creating some flexibility in the deposition strategy.

Both TSFs are conventional day wall paddock facilities with a fixed penstock tower arrangement that would be the primary means of draining excess water from the facility. Once excess water is drained from the facility, it follows a series of trenches that flow into the 12A, 12B, 12C and Dam 13 Return Water Dam (RWD) system. Water that enters 12B is pumped back to the plant to be used in the process again.





*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 and Transport Agreement, covering all Harmony Gold Plants, in place with Sasol South Africa, as the sole supplier of liquid Sodium Cyanide, delivered by bulk tanker. This Supply and Transport Agreement includes Harmony One Plant. Sasol South Africa is a signatory to the Cyanide Code and was recertified as a fully compliant Production Facility with the ICMI Cyanide Code on 23<sup>rd</sup> January 2019.

**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:*

There is a Harmony Group-wide, cyanide Supply and Transport Agreement, covering all Harmony Gold Plants, in place with Sasol South Africa, as the sole supplier of liquid Sodium Cyanide, delivered by bulk tanker. Sasol South Africa is also responsible for the



transport of cyanide, solely using Tanker Services Food and Chemicals/Imperial Logistics. Tanker Services Food and Chemicals/Imperial Logistics was recertified as an ICMI transporter on 21<sup>st</sup> November 2018. A Memorandum of Agreement (MOA) for the off-loading of liquid sodium cyanide in terms of SANS (South African National Standards) 10231:2006 between Tanker Services Food and Chemicals/Imperial Logistics and Harmony Gold Mining Company is in place. The cyanide Supply and Transport Agreement and the 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:*

There is a Harmony Group-wide, cyanide Supply and Transport Agreement, covering all Harmony Gold Plants, in place with Sasol South Africa, as the sole supplier of liquid Sodium Cyanide, delivered by bulk tanker. Sasol South Africa is also responsible for the transport of cyanide, solely using Tanker Services Food and Chemicals/Imperial Logistics. Tanker Services Food and Chemicals/Imperial Logistics was recertified as an ICMI transporter on 21<sup>st</sup> November 2018. A Memorandum of Agreement (MOA) for the off-loading of liquid sodium cyanide in terms of SANS 10231:2006 between Tanker Services Food and Chemicals/Imperial Logistics and Harmony Gold Mining Company is in place. The cyanide Supply and Transport Agreement and the MOA cover the responsibilities and requirements including safety, emergency response (spills prevention and clean-up), risk assessments, emergency response resource access and availability, training, and communication.

Chain of custody records sighted and sampled confirm all elements of the supply chain, and all identified transporters are in compliance with the Code.

**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. The previous recertification audit observed the following: Design drawings: GA (General Arrangement) of liquid sodium cyanide tanks 031-0244-128-M2923 rev. 2, 2nd October 1984, Civil drawings of bund area and plinths for cyanide storage, 031-0244-128-M2994 rev 1 2/10/84, Sodium Cyanide storage tanks 1,2,3 detail 031-0244-128-M2499 rev.2 of 2/10/84, and P&ID (Piping and Instrumentation Drawing) 031-0244-128-E0295. There has been no change to the storage facilities in the period since the previous recertification audit. Technical Inspection Reports on the Sodium Cyanide Bulk Storage Facility, conducted by Sasol South Africa, were sighted. The Reports dated 8th January 2019 (100%), and 27th January 2020 (98%) showed high compliance ratings.

The cyanide storage tanks have ventilation pipes and are located inside a concrete bund and installed on steel legs with a conical bottom. The structures were designed and located on concrete and away from people and surface waters. They are located 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, next to the cyanide area and all spillages or washings drain to the cyanide bund area. The cyanide storage tanks, which are located inside concrete banded areas, and have ultrasonic level indicators equipped with digital displays at the storage area and with high level alarms set to go off at 85% and 90% of actual capacity in the control room system. The Instrument Technician confirms the tank levels every morning, and keeps a record of the graph readout. The electronic level indicators are sealed units and are replaced on breakdown. The two tanks are interconnected and are interlocked with the off-loading air, which closes off any off-loading at 95% of tank levels. 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 the cyanide storage tanks. The off-loading procedure is detailed, spelling out PPE (Personal Protective Equipment) requirements, the use of a buddy in the process, and clearly sequenced to prevent spillages and accidental releases during liquid cyanide off-loading. The Liquid Sodium Cyanide is coloured light to dark red, which is added at the cyanide production facility at Sasol. The Sasol Sodium Cyanide Safety Data sheet clearly indicates that the liquid's coloured light to dark red.

**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 utilising 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 40 cyanide process-related procedures, 13 Cyanide emergency procedures and 19 cyanide equipment procedures. There are also 2 cyanide-related environmental procedures and a set of 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 by new contractor, Intasol.

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. These cover tanks, secondary containments, ponds and impoundments, pipelines, pumps and valves TSF Quarterly Reports were reviewed, along with the Annual External Audit reports. Concerns were raised regarding TSF stability, but reinforcing work and on-going inspections are managing the situation. 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. The inspections are deemed at appropriate frequencies, sufficient to assure and document that cyanide facilities are functioning within design parameters.



In the case of an upset in the facility's water balance, the Plant has procedures which cover: - Reacting to a High Storage Alarm, High Cyanide Levels I residue Slimes, Plant Stopping and Starting procedure, and starting and Stopping Cyanide Pumps. The Plant operates continuously over breaks such as Christmas. However, there is a site-specific procedure, "Harmony on Plant Return to Work and Start-Up Process" which refers to existing Stop/Start procedures and was specifically developed to deal with start-up and return to work, coping with Covid-19 risks.

The plant maintenance and inspection schedule include preventative maintenance inspections on cyanide critical equipment, using a computerised Planned Maintenance System (PMS) called the DMS2000 system. Inspection documentation includes the name of the inspector, the date of the inspection, observed defects and repairs, and a job card request for more significant repairs that may be required. The DMS system is used to track the job card and the completion date. A new OCR scanning system is being introduced, which will enable automatic raising of a job card, if the inspection raises a non-conformance on the checklist question. A change management procedure covering health, safety and environment is in place and operational.

The Plant is designed with sumps and sump pumps that would return spillages back to the process. The emergency surge dam is in place, linked with concrete-lined spillage trenches, providing back-up capacity in case of any power outages at the Plant. No emergency power is required at the TSF. There is a generator and emergency pump for the return water dams in case of a prolonged power outage. These are included on the PMS.

*Standard of Practice 4.2: Introduce management and operating systems to minimise 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:*

Ore for the Plant is received from 5 shafts, in addition to processing waste rock material. Ore samples are sent to SGS Laboratories to conduct total element analysis to determine the cyanide addition rate. This is conducted approximately every 3 years because the ore remains constant. The Preliminary Report 16/767 16/2/2017, Metallurgical testwork on samples from Harmony One Plant Freestate, was sighted and reviewed. A graph of dissolution versus cyanide consumption was sighted, which indicated optimum cyanide concentration is 190 ppm.

Metallurgical testwork for Joel and Unicel: Metallurgical Report Number 19/699/19/648 Dated 8th June 2020 indicated presence of locked gold. Pyrophyllite is present and

increases cyanide consumption. The Report thus characterises the two ores in terms of cyanide consumption and other metallurgical factors. Bottle roll tests are done monthly for tests on recovery. The 2020 tests per source dated 21st July 2020 were sampled. Leach cyanide consumption is plotted on a graph weekly, and any variabilities are discussed by a cross-disciplinary Plant team.

Flow meters have been installed on the three cyanide dosing points (i.e. one for each module). The flow meters are used, in conjunction with the feed forward ratio control, to even out the addition of cyanide reagent, preventing sudden spikes in the cyanide addition. The TAC 1000 cyanide analyser is used as feedback control for cyanide addition to control cyanide concentration in all three modules.

In addition, 2 hourly samples for free cyanide titration are taken from the first Leach Tank and last leach tank and last adsorption tank. Titration values are compared with the TAC 1000 analyser in leach tank 1 and investigated if the discrepancy is significant.

Precip. Solution (solution remaining once the gold has been precipitated) is returned to the leach from the Smelt House. This is used to reduce the quantity of cyanide addition.

With regard to other control strategies, Artificial Intelligence (AI) control strategies may be investigated.

*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:*

The probabilistic Water Balance (PWB), developed by Jones and Wagener; Engineers, continues to be used for the TSF water balance. The PWB was reviewed for 2018, 2019 and 2020. The PWB includes: - rainfall onto the TSF's, water in slimes from Harmony 1 Plant, side slope runoff, penstock return to return water dams, toe drain to return water dams, water from paddocks to return dams, evaporation, lock up water in TSF settled slimes, and seepage loss. The model includes the legal freeboard requirements to cope with a 1:50 year, 24-hour storm event, plus 800mm of additional freeboard. Measured rainfall is collected at the TSF and records cover 2013 to 2020. Additional rainfall data is included from the nearby Odendaalsrus weather station from 1920 to the present.

A separate PWB has been developed for the Plant and includes the following: - water in the ore, return water dam 12b, water in mud, rainfall into bunded areas and reservoirs, - and stormwater after return to Plant. The stormwater dam component includes: - runoff from the Plant, rainfall, the basin runoff, evaporation, overflow, seepage, and change in storage.

There is a Water Management Procedure in place which manages the two water balances to prevent overtopping of the return water dams and ensures that the emergency Plant Surge Dam is kept empty to keep spare storage space for abnormal or emergency



conditions. The procedure describes the Harmony 1 water management system and its overlaps and links with the dams which service Harmony Saaiplaas and Central Gold Plants. It includes critical and target freeboard levels for dams, actions for normal, abnormal and emergency situations, specific roles and responsibilities, monitoring and inspections, and response plan scenarios for the different dams in the system.

The procedure, Respond to Abnormal and Emergency Conditions, stipulates that the Plant Surge Dam (PSD) should be kept empty and the pump operational at all times, in order to prevent the dam from overflowing.

The operating practices are reviewed during quarterly and annual TSF reviews, which include checking 1:50 and 1:100 year rainfall events to ensure that abnormal and emergency responses are still relevant.

The TSF freeboard is measured as per the Intasol daily, weekly and monthly reports and also surveyed using drones and Lidar (**L**ight **D**etection **a**nd **R**anging). The freeboard is also reported in the annual and quarterly reports. 2018 and 2019 annual reports were sampled and reviewed, as were the quarterly reports.

*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 (Weak Acid Dissociable) cyanide values in graph form for 2018, 2019 and 2020 were reviewed. The graphs showed on-line WAD cyanide levels leaving the Plant, weekly WAD cyanide tip point levels, and calculated WAD cyanide levels at the tip point, based upon degradation measurements in the TSF pipeline and correlations with the weekly WAD cyanide tip point measurements. Exceedances were identified during 6 to 12th June 2018. The exceedances were investigated, causes identified and corrective action implemented, resulting in restoration in WAD cyanide compliance levels. Daily monitoring for bird mortalities did not identify any incidents on the TSF, and the monitoring of the open waters in the TSF pool has shown WAD cyanide levels of below 50 mg/l.

Evaluation of WAD cyanide data for the rest of 2018 shows that no further issues were encountered. The graphs indicate clearly that there were no other significant or unexplained exceedances of the 50mg/l WAD cyanide limit during the three years since the last certification. As a result, no additional measures to restrict wildlife and livestock were required.

TSF contractor, Intasol, monitors wildlife mortalities daily and daily inspections are bound in monthly books. The sampled daily inspection records indicated no mortalities and staff interviewed reported no cyanide-related wildlife mortalities since the last certification audit. It is therefore deemed that the 50mg/l WAD cyanide limit is effective

in preventing significant wildlife mortalities. The operation does not operate heap leach facilities.

*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, and this was verified during the site inspection. The operation also does not have any indirect discharges to surface water. The closest stream is 3 km away and no seepage could reach the stream.

Groundwater boreholes are sampled for WAD cyanide on a weekly basis. With the exception of 3 spikes, all other values were less than the limits of detection. Two of the spikes were found to relate to the presence of a dead animal in the borehole.

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

**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. The Plant is equipped with cement bunds, the roads are brick-paved, and the surge dam is lined with a plastic liner to minimise seepage to groundwater.

There is no numerical standard established by the applicable jurisdiction for WAD cyanide or any other species of cyanide in groundwater, therefore there are no compliance points below or down gradient of the gold plants or tailings facilities.

Groundwater boreholes are sampled for WAD cyanide on a weekly basis. With the exception of 3 spikes, all other values were less than the limits of detection. Two of the spikes were found to relate to the presence of a dead animal in the borehole.

Current Backfill standards limit the cyanide in the final product sent underground to 20ppm free cyanide. The backfilling takes place close to the Bambanani Shaft. A procedure in place stipulates that a titration must be done to confirm that the WAD

cyanide level is below 20 ppm when the product is sent underground. Ferrous sulphate is added to lower the WAD cyanide. The auditors observed a Backfill calculator, which is used to ensure that the correct number of bags of Ferrous Sulphate is used to ensure that the backfill sent underground is below the 20 ppm WAD limit. The backfill plant was not operational at the time of the audit. However, the backfill plant continues to be operated, albeit less frequently, with all the normal PMS inspections and checks being undertaken.

*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 are placed in bund areas on solid concrete bases. The CIL (Carbon in Leach) and Leach tanks are placed on solid concrete bases, draining onto a competent concrete floor into a spillage sump and pump, returning any spillage to the 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, stormwater 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 surge 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>. In addition, the dam would accommodate the 1:50 year storm event, and an operating procedure requires that the emergency containment dam be kept empty at all times, and the pump kept operational.

The reagent strength pipelines were risk assessed, and secondary containment launders were installed over the whole length of the pipeline. All slurry pipelines in the Plant run across concrete-lined or paved areas, draining to the emergency surge dam via concrete-lined trenches. The tailings pipeline is concrete-lined from the tailings pumps to where it crosses the perimeter wall as a preventative measure. There are also rubber-lined bends from the tailings pumps to where it enters the ring mains of the TSF. This is deemed a measure to reduce the risk of pipe leaks due to erosion and corrosion.

There are shiftly drive-by inspections of the TSF pipeline by Plant Security, and annual thickness tests are conducted in terms of the DMS 2000 PMS system. Pipelines and tanks constructed of mild steel and rubber-lined, where appropriate, to be compatible with cyanide and high pH conditions.

The area where the TSF pipeline runs next to the Witpan (a man-modified closed body of water which is the outflow of the municipal sewage system) and is flanked by earth



bunds to contain spillages and protect the surface water. However, the failure of the municipal pumping system has meant that water from the sewage works enters the Witpan instead of being pumped to the Mostert canal, which has caused a rise in the levels in Witpan. In order to reduce the risk of contamination of the pan, One Plant has moved the residue pipeline further away from the encroaching shoreline. The Plant installed a concrete-lined pipe and installed earth bunds to effectively create a barrier between the pipeline and the pan. Where there was additional space, secondary containment bunds were also constructed to intercept any spillages from a burst pipe before it enters the pan. The residue pipeline is concrete-lined as an additional measure to prevent leaks. An additional spillage paddock is in place above the flood line of the Witpan to provide additional protection. The pipeline is also inspected daily for leaks.

*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.*

**X in full compliance with**

**The operation is**                       in substantial compliance with **Standard of Practice 4.8**  
  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

In the original certification audit, in the absence of QA/QC documentation, an appropriately qualified person reported that the facility could be operated as fit for purpose. The annual Plant structural audit covers inspection of tanks, structures and supports for structural integrity and corrosion. The Annual Structural Safety Audit Report, dated December 2018, was reviewed, and only one emergency repair requirement (i.e. potential for serious damage, should be done within 12 months.) was noted. This was a severely corroded square hollow section beam element which was encountered at the western end of the installation. The Report was prepared by a registered Professional Engineer. The author reports, "...We wish to point out that the emergency repairs, which were highlighted in our previous Report have been resolved. Repair and maintenance teams were also active on FS One Plant during our inspections. This is evidence of Harmony's commitment to keeping their installations safe and serviceable...." Also reviewed was the Annual Structural Safety Audit, dated January 2020. This Report was also prepared by the same registered Professional Engineer. Only one emergency repair was reported, and that was in the Adsorption area and were two severely corroded structural steel elements that must be replaced, In the Executive Summary, it is reported, "...that the emergency repairs, which were highlighted in our previous Report have been resolved. Repair and maintenance teams were also active on FS One Plant during our inspections. This is evidence of Harmony's commitment to keeping their installations safe and serviceable..."

Since the previous recertification audit, No. 1 Plant used TSF: FSS2, and FSS 8 West, and FSS East 1 and 2. Stability deteriorated over a period of 3 years on the FSS 8 TSF



complex, and in late 2019, seepage and sloughing increased. The portion of tailings deposited on FSS 8 complex (which was approximately 60%) was diverted to the St Helena 1, 2 and 3 TSF complex with the remainder still deposited on FSS 2 (50:50 split). Remedial options were investigated and reviewed by Jones and Wagener (J&W), Professional Geotechnical Engineers, and implemented as per their proposals. A new residue pipeline from the plant to the split valve going to the deposition sites was recently added, for which the MOC (Management of Change exercise) was sighted during the audit. Those QA/QC records form a part of the normal TSF “work-in-progress” documentation.

Auditors tracked the progress of the identification and remediation through the reports in the quarterly meetings and the annual reports. The third quarter 2020 report on TSF FSS2 TSF, General Conclusions, include that no major concerns are raised regarding FSS2 TSF. The facility meets the legal freeboard requirements. No visual signs of instability have been reported.

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

**X in full compliance with**

**The operation is**

in substantial compliance with **Standard of Practice 4.9**

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

Procedures for environmental monitoring (including the processes for sample preservation, chain of custody, “how samples are taken and where”, and cyanide species analysed) of surface water and borehole water, developed by a competent person, were sighted and checked. Sampling conditions reported on the Result report sheets, contain information on human influences, livestock and wildlife, weather conditions and any additional extraneous comments. Sampling frequencies are deemed adequate to characterize the medium being monitored and to identify changes in a timely manner. There are no discharges to surface water, but boreholes are in place up and down stream of the Plant. Surface water sampling is done monthly, and borehole sampling is done weekly, with plant borehole sampling being done weekly. Wildlife is monitored daily on the TSF for any mortalities. WAD cyanide in open waters is sampled on-line using a WAD 1000 analyser, backed up by weekly samples by the Environmental Department as the independent check.

**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, dated 12th August 2020, is in place which includes a 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 Report, Closure Cost Report, Bambanani, prepared for Harmony Gold Mining Company Limited, dated June 2020, was reviewed. In Section 1.12 Cyanide Decontamination, it states, "...Harmony is a signatory to the International Cyanide Management Code... Thus, Harmony, as a signatory, is required to set aside money for the closure of the cyanide plant. A figure of R 652,569 has been included for the cleaning and removal of sodium cyanide systems. This figure is based on a quotation from a reputable Cyanide Cleaning Specialist. The basis for this figure includes the following activities:

- Test for explosive gas and high pressure (HP) cleaning of tanks and equipment;
- Flame cut all lines and equipment into 1 metre lengths for safe disposal; and
- Removal of all cyanide pipes and drip trays from Cyanide Tanks to Pachuca's..."

A quotation by Rocket Industrial Services, dated 6/7/2020, for the decommissioning cost of R 333 258.51 was sighted.

Closure cost estimates are updated on an annual basis, as per the requirements of the South African Minerals and Petroleum Resources Development Act, No 28 of 2002. The estimates are reviewed externally every 2 years.

The Bambanani, Joel, Matjabeng and Tsepong Rehabilitation Trust Fund financial statements for the year ending 30th June 2019, prepared by Price Waterhouse Coopers



and signed 12th June 2020 by Hendrik Odendaal, registered financial auditor, were sighted. It is required by law in South Africa that a trust fund be established to fund decommissioning and closure strategies, including cyanide.

**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 40 cyanide process-related procedures, 13 Cyanide emergency procedures and 19 cyanide equipment procedures. There are also 2 cyanide-related environmental procedures and a set of 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 by new contractor, Intasol. It was confirmed that the TSF and Plant procedures require the use of PPE as appropriate to the tasks. The SLAM (Stop, Look, Assess, Manage) system is used as pre-work risk assessments and inspections for all tasks. A change management procedure covering health, safety and environment is in place and operational.

Toolbox talks are the channel of communication to pass on proposed changes to procedures or to inform on changes in procedures. The dialogue is two way and active. This was confirmed during the interviews with selected employees. Workers are involved in risk assessments relating to changes in procedures, methodologies, processes and activities. The SLAM system is an effective and operational methodology to assess risk and communicate concerns regarding actions and managing safety and risks. It is used by all staff and an effective means of incorporating worker inputs into health and safety procedures. This was confirmed during the interviews with selected employees. A Training Shift is scheduled for each Thursday. During the shift, changes in Procedures are communicated to the specific group being affected by the changed procedure. A monthly Plant Safety Representatives meeting is held, including the TSF Safety Representatives, who report issues, concerns, and commentary raised from the workforce. This was confirmed during the interview with the Safety Representative.

*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 on the line before the thickener to 10.5 and controlled via 2 hourly, lime titrations. The procedure states that before cyanide is added into the pulp at the Leach section, it is imperative that the pH is >10.5. Discharge points of cyanide must always enter the process where the pH is maintained above 9.8 and which is well ventilated at all times. The procedure stipulates the reporting procedures and actions required, in the event that the pH drops below 9.9.

HCN (Hydrogen Cyanide) gas “hot spot” surveys are conducted quarterly. There are 10 fixed polytron HCN gas monitors: - 3 at the cyanide dosing points on leach 1, 2 and 3, 3 at the cyanide storage facility, 2 at the cyanide off-loading area, 1 at caustic cyanide make up, and 1 at the Backfill plant. Use is also made of 16 PAC 7000 portable HCN gas monitors – 9 monitors in the Plant, 3 monitors at the TSF, 1 at St Helena Hospital, and 3 at the Backfill plant.

Fixed and portable HCN gas monitors alarm at 4.7 and 10 ppm HCN gas. Portable monitors include software to calculate and alarm when the worker is exposed to 4.7 ppm HCN gas continuously over an eight-hour period. At 4.7 ppm, the alarm will sound, and the operator must report immediately to the Shift Foreman who will investigate the cause of the increased HCN gas levels. When the alarm sounds at 10ppm, employees are trained to evacuate immediately.

Hydrogen cyanide monitoring equipment is maintained, tested and calibrated, as directed by the manufacturer, and records are retained for at least one year. The manufacturer, Dräger, conducts calibration of the fixed and personal monitors every 3 months although the manufacturer recommends every 6 months. Dräger Harmony Gold Service Reports dated 26th August 2020, 25th May 2020, 14th January 2020 and 5th September 2019 were reviewed. The reports contain the calibration certificates of the fixed and portable monitors on site. The Plant instrument technicians carry out basic maintenance and bump tests on a monthly basis, triggered by reminders from the DMS PMS system. This was verified during the electronic review of the DMS system.

It was observed during the site inspection that safety showers, low-pressure eyewash stations and dry powder fire extinguishers have been placed at the cyanide off-loading and storage areas, leach section and other strategic areas. Safety showers as listed on the DMS PMS and are inspected by Operations department weekly, and maintenance department monthly. The records were reviewed and sampled electronically and confirmed. Fire extinguishers are inspected by fire equipment contractors monthly and serviced annually. This was verified on sampled fire extinguishers during the site inspection.

Warning signs have been placed at the Cyanide off-loading and storage area, at Leach, dosing points of all three modules, and the Backfill Plant. The signboards include no eating, no drinking, no smoking, and no naked flames. PPE requirements are stipulated on the signboards at the specific areas as well as the entrance to the Plant. TSF signs have

been erected along the perimeter of the TSF's to warn about entering the area, not to swim or drink the water. Warning signs at the TSF access points have been erected. Concrete signs are used to warn of no potable water: no eating and drinking, no swimming, no livestock, no cycling, no walking, and no motorcycling. English is used together with pictograms on the signs.

Pipe labelling, including direction of flow, of the reagent strength pipelines on the Plant was confirmed during the site inspection. The TSF slurry lines are labelled at crossings with the wording, "poisonous water". Safety Data Sheets (SDSs) are located throughout the Plant at the cyanide storage cabin and on noticeboards. The SDS's include specific reference to the cyanide solution colour of light to dark red. Cyanide first aid boards and medical protocols were sighted at dosing points, the cyanide storage area, and the first aid cabin at the entrance to the plant area.

Accident and incident reporting and investigation procedures, based upon the site safety reporting requirements, were found to be in place and effective. No cyanide-related incidents or accidents have been reported 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.*

**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:*

It was confirmed during the site inspection that water, hand-operated resuscitators, medical oxygen, antidote kits (Tri-pacs including Amyl Nitrate and activated charcoal) and two-way radios/telephones, and man-down alarms are readily available for use at the unloading, storage and leach areas, backfill area, and first aid room. Safety showers are linked to an alarm and show on the SCADA (**S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition) system in the control room when activated. Man-down alarms are available at the cyanide off-loading and storage area, the Leach and Elution areas, and the Backfill Plant and these also show on the SCADA system in the control room.

At the TSF, communication is carried out via two-way radio and cell phones with the plant control room. Medical oxygen is available in the LDV (Light Delivery Vehicle) associated with the TSF. A sealed first aid kit is carried in the LDV, as well as with the Teams on the TSF. It is checked every month, and if the seals are broken, the kit is then refurbished.

During the site inspection, it was confirmed that all Plant antidotes were stored in fridges and expire in July 2021. The Backfill antidote kits expire in July 2021, as confirmed during the site inspection. It is the business unit leaders' responsibility to ensure the timeous ordering of the cyanide antidote from St Helena Hospital, which is the local Mine Hospital. Inspection checklists in cabinets where the first aid equipment is kept

were sampled and reviewed. The Plant also has checklists for the Emergency Room, The Cyanide Medical and General Equipment and Emergency Trailer.

All plant personnel and fixed-term contractors have been trained in Cyanide First Aid and are therefore able to respond to a cyanide emergency. All plant staff are trained on decontamination and administration of oxygen and antidote. All employees are required to complete First Aid Level 2. A dedicated, day shift emergency response team is also available and consists of 11 members. The team receive the following additional training: Fire marshal training, PAC 7000 personal HCN gas monitor training, SCBA (Self Contained Breathing Apparatus) set, CPR (Cardiopulmonary resuscitation) and Defibrillator training. A fully equipped cyanide emergency room and cyanide emergency trailer is available in the Plant. This was confirmed and checked during the site inspection.

Agreements are in place with the St Helena Hospital and Netcare 911 (Ambulance service provider) for the transport and treatment of cyanide patients. The Hospital staff are given cyanide awareness training annually. A Procedure, "Ambulance Entry in the event of an Emergency", describes the process to follow during an incident to notify the ambulance service, and to allow Plant access and egress and accompany the patient to hospital. Similarly, the Backfill Plant Procedure, "Emergency response plan injury procedure, states, "...arrange for ambulance entry with security personnel main gate...". St Helena Hospital has been used by the mine since 2015. A full project, including MOC (Management of Change), was used to communicate the cyanide emergency responses to St Helena Hospital. The Hospital is also included in full-cycle drills from all the Harmony Free State Gold Plants.

Emergency exercises are conducted periodically from the Plant to the hospital, and additional cyanide drill training is done and documented.

**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 a Harmony 1 Plant: Cyanide Emergency Preparedness Procedure and has further developed site-specific cyanide emergency scenarios and responses in terms of its emergency responses.



On the TSF, Intasol has an Intasol Emergency Preparedness plan. There is also a specific procedure, "Slimes Dam Emergency Procedure for Harmony One Plant", and the TSF COP Harmony Gold Mining Company Limited Free State Operations, Tailings Dams, Mandatory Code of Practice for Mine Residue Deposits COP 2 includes TSF emergency procedures. The transporter used by No 1 Plant is an ICMI-certified transporter, and is responsible for all transportation-related emergencies on the transportation route.

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. Specific briefing meetings are also held with the various emergency services, as detailed in Principle 9 below.

*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 procedure details clear duties, roles and responsibilities for the various emergency scenarios. The Plant Control Centre will be the central coordination point of all cyanide emergencies and will liaise with plant management on the commitment of necessary resources. The Mandatory Code of Practice For Cyanide Management, Harmony One Plant, COP 8, Section 4.8.7, Emergency Equipment, lists all of the emergency response equipment to be used and site inspections confirmed availability and readiness. The procedure depicts a flowchart indicating the people (by

job description) that should be contacted in the event of various emergency scenarios. Contact details are available on contact lists and standby lists. The procedure lists roles and responsibilities for: - First Responder, Control Room, Netcare 911 control room, Plant Manager, Plant Engineer, Safety Officer, Security Officer, Process Unit Leader and Engineering Foreman, Emergency Team Captain, Standby Official and Shift Foreman, and Shift personnel. For a Slimes Dam Emergency, roles and responsibilities are also included for the Slimes dam Foreman, Environmental officer, and Environmental Manager. Communities have no role in the emergency response procedure, but they are kept informed through on-going dialogue. (See principle 9 below.)

The Cyanide Emergency Procedure is presented to all new and other plant employees attending induction or refresher training at the Harmony 1 Plant's training centre. All contractors working for longer than three days at Harmony 1 Plant will also undergo training in the cyanide emergency procedure.

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 procedure depicts a flowchart indicating the employee (by job description) that should be contacted in the event of various emergency scenarios. Section 10, Pages 9-12 includes roles and responsibilities and who needs to be notified by whom, and Section 11, Page 13, contains all the contact telephone numbers for management, regulatory agencies, outside response providers and medical facilities. Media communication is also dealt with in the procedure. In this respect, the procedure states that employees will not disclose any information to the press or public. Only the Chief Operating Officer may release information.

*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 neutralisation processes and materials is clearly covered, as is the disposal of contaminated materials and the use of treatment chemicals such as ferrous sulphate in surface water which is prohibited.

With respect to the use of treatment chemicals into waterways, The Handling and Cleaning of spills procedure states, "..., Sodium hypochlorite, ferrous sulphate and hydrogen peroxide are all hazardous to aquatic life and should not be used to treat a cyanide release once it has entered surface water. This prohibition also applies to normally dry drainages since these may flow in response to precipitation and deposit residual treatment chemicals into downstream surface water..." In Section 8, it further states, "...This prohibition also would not be necessary in a situation where concerns with protection of human health outweigh the risk to aquatic life..." The procedure, "Use of Ferrous Sulphate as cyanide neutralizing agent", indicates where the ferrous sulphate is stored, how the substance is to be prepared, and what PPE is to be used.

The Handling and Cleaning of spills procedure states, in Section 6, "...Water samples must be taken at the point where the slime or solution enters the clean water system as well as above and below this point and analysed for the chemical that may be present in the slime or "dirty" water as well as uranium. It is vital that the necessary sample preparation measures are followed, when taking the samples, as required by the laboratory doing the analysis, to ensure that validity of the sample results. The results of these analyses must be forwarded to the Environmental and Group Radiation Managers..."

*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 under the following circumstances: -

- After a cyanide incident or accident has occurred;
- After a cyanide drill has been held and changes are required;
- Biennially;
- After process modification which may affect the use of cyanide; and
- After modification to the safety equipment, e.g. safety shower, safety alarms, etc.

A series of Emergency cyanide drill reports were sighted and reviewed.



- Cyanide drill: gas inhalation at the backfill plant on 7th September 2020. Critical feedback included: - The Ambulance arrived late, and they had no cyanide PPE; Netcare 911 ambulance control room dispatch department was not aware on how to react on a cyanide emergency, and wrong information was relayed to the ambulance; the wind direction was not checked, and amyl nitrate not available. Positive points noted were that the Bambanani shaft and security staff responded well to ambulance arrival.
- Gold Plant drill: cyanide inhalation at the off-loading tanks on 4th September 2020. Critical feedback included: - the windsock at the cyanide area was in poor condition, Netcare 911 Ambulance control room kept plant control room on telephonic hold, and the ambulance only arrived after 40 minutes.
- Gold Plant drill: Cyanide inhalation on 21st August 2018 at assembly point to demonstrate emergency treatment. Learning points: - PPE usage issues, liaison with St Helena hospital needs improvement, and improvement in reaction time was noted.
- Gold Plant: Cyanide splashing drill on 7th August 2019. Learning points: - emergency contact list at the control room was not updated, there was no emergency checklist at the control room, Netcare 911 ambulance fast response team arrived with correct cyanide PPE, and the PAC 7000 gas monitor was not used. The learning points were allocated to specific persons for corrective actions.

**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 Intasol, TSF contractors) are trained in basic cyanide awareness. The plant training matrix includes a flagging system to timeously indicate the need for training and refreshers. The contractor training matrix and the Backfill staff training records were also sighted and reviewed. 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.



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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.*

**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. Trainers' certificates were sighted and confirmed. The Harmony Group Metallurgy training establishment is formally ISO 9001 accredited. All employees are trained before being allowed to work on a cyanide section. The Foreman assesses the trainees and the e-learning system uses multiple-choice questions to test competency and knowledge. A Clock-in card to enter the Plant is only issued after cyanide training sign-off in the e-learning system is complete. The employee is only allowed to perform the specific job following assessment by the Foreman using a PTO (Planned Task Observation). All transferred employees will be given an assessment before being allowed to work on the section, as per managerial instruction A formal PTO system is in place and if identified by the PTO, specific re-training may be given. TSF refresher training is done annually and annual refresher training on operational tasks, using the SWP's (Standard Work Procedures), is conducted. This was confirmed in the training matrix. Records are retained for 40 years on the Plant, after which the records are sent to the central Harmony 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. Emergency Response Team members are trained to administer amyl nitrate ampoules, but only Medical Practitioners and trained paramedics are permitted to administer antidote intravenously. The team receive the following additional training: Fire marshal training, PAC 7000 training, SCBA set, CPR and Defibrillator training. After-hours shifts receive induction training, including cyanide first aid. There are employees on shift that also received the higher

level of cyanide emergency training. Formal drills to test the emergency procedure for cyanide first aid treatment are done on a quarterly basis, and the complete response chain first aid, ambulance, and hospital, is audited on at least an annual basis and action taken where appropriate. Cyanide drills are the primary training tool used to train the emergency planning. St Helena Hospital has been used since 2015. A full project plan, including MOC (Management of Change), was used to communicate the cyanide emergency responses to St Helena Hospital staff. The Hospital is also included in full-cycle drills from the Harmony Free State Plants. There are no community members 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 the Plant, after which the records are sent to the central Harmony 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. The following stakeholders were identified: All Emergency Departments, Community around the Mining Areas, Farmers around the Mining Areas and Livestock owners and cattle herders, Boiketlong village, and Brand 5 hostel. Public flyers entitled "Cyanide Management at Harmony One Plant" were posted to all stakeholders:

A Cyanide Meeting chaired by J Botha (No 1 Plant Process Manager) was arranged to discuss the management of cyanide emergencies on the Matjabeng municipality area on 13th March 2019. The Meeting with the Emergency Services included: - SAPS (South African Police Service) flying squad, Matjabeng Fire and Rescue, Paramedics, One Life 911 ambulance service, ER24 ambulance service<sup>3</sup>, Netcare 911 ambulance service, St Helena Hospital, EMS (Provincial Emergency Medical Service), AHC EMS (African Health Care Emergency Medical Services), RH Matjabeng Private Hospital (Previously Ernst Oppenheimer Hospital), and Environmental Health Practitioners. Feedback notes were recorded. The No 1 Plant Gold Plant Cyanide Awareness Presentation, used at the meeting was sighted. Cyanide public communication flyers were posted to the stakeholders, and copies were sighted.



The presentation, "Harmony Gold Mine Cyanide Awareness Presentation", used for communication to the communities was reviewed. The presentation includes: Production, Transportation, Training, Dialogue, Operations, and Emergency Response. Minutes of the environmental consultation and cyanide awareness session held over 3 days from 19-21 November 2019 were reviewed. The meetings were attended by over 80 people, including medical staff from Life 911, St Helena Hospital, RH Matjabeng private hospital, Mediclinic, EMS Freestate, AHC EMS (African Health Care Emergency Medical Services), and Lejwe Leputswa district municipality traffic department. A series of practical and pertinent questions were asked, some of which were answered and others were referred to Harmony Management. A Meeting with cattle herders on cyanide was held on 21st March 2019 Bambanani West, and again on 24th March 2019 Bambanani West. The meeting was held in Sesotho, the local language.

*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. The following stakeholders were identified: All Emergency Departments, Community around the Mining Areas, Farmers around the Mining Areas and Livestock owners and cattle herders, Boiketlong village, and Brand 5 hostel. Public flyers entitled "Cyanide Management at Harmony One Plant" were posted to all stakeholders:

A Cyanide Meeting chaired by J Botha (No 1 Plant Process Manager) was arranged to discuss the management of cyanide emergencies on the Matjabeng municipality area on 13th March 2019. The Meeting with the Emergency Services included: - SAPS (South African Police Service) flying squad, Matjabeng Fire and Rescue, Paramedics, One Life 911 ambulance service, ER24 ambulance service, Netcare 911 ambulance service, St Helena Hospital, EMS (Provincial Emergency Medical Service), AHC EMS (African Health Care Emergency Medical Services), RH Matjabeng Private Hospital (Previously Ernst Oppenheimer Hospital), and Environmental Health Practitioners. Feedback notes were recorded. The No 1 Plant Gold Plant Cyanide Awareness Presentation, used at the meeting was sighted. Cyanide public communication flyers were posted to the stakeholders, and copies were sighted.

The presentation, "Harmony Gold Mine Cyanide Awareness Presentation", used for communication to the communities was reviewed. The presentation includes: Production, Transportation, Training, Dialogue, Operations, and Emergency Response.

Minutes of the environmental consultation and cyanide awareness session held over 3



days from 19-21 November 2019 were reviewed. The meetings were attended by over 80 people, including medical staff from Life 911, St Helena Hospital, RH Matjabeng private hospital, Mediclinic, EMS Freestate, AHC EMS (African Health Care Emergency Medical Services), and Lejwe Leputswa district municipality traffic department. A series of practical and pertinent questions were asked, some of which were answered and others were referred to Harmony Management. A Meeting with cattle herders on cyanide was held on 21st March 2019 Bamabanani West, and again on 24th March 2019 Bamabanani West. The meeting was held in Sesotho, the local language.

*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 in English and Sesotho were distributed to communicate cyanide issues and explain cyanide and its uses. The presentation, Harmony Gold Mine Cyanide Awareness Presentation, is used as a basis for explanation. 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, along with the Departments of Water and Sanitation and Environmental Affairs, do not necessarily make the information publically available. Similarly, spills and releases must be reported to the Departments of Water and Sanitation and Environmental Affairs. Transport related incidents are reported by Sasol South Africa and the transporter, Tanker Services Food and Chemicals/Imperial Logistics, 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. Page 118 of the Harmony Integrated Report 2020 includes a discussion on the Cyanide Code in the Harmony Group. (<https://www.harmony.co.za/invest>)

Information on significant cyanide exposures and releases would be made available, after appropriate investigations, via the annual Harmony Integrated Report (<https://www.harmony.co.za/invest>), should incidents occur.

