

***INTERNATIONAL CYANIDE  
MANAGEMENT INSTITUTE***

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

***Summary Recertification Audit Report***

***Harmony Gold Mines Limited  
Doornkop Gold Plant  
South Africa***

***7<sup>th</sup> – 11<sup>th</sup> December 2020***



Name of Operation: Doornkop Gold Mine  
Name of Operation Owner: Harmony Gold Mines Limited  
Name of Operation Operator: Harmony Gold Mines Limited  
Name of Responsible Manager: Jan Roos - Plant Manager  
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**Location detail and description of operation:**

Doornkop Gold Plant is situated 15km south of Krugersdorp, next to the R558 road en route to Lenasia and 25 km west of Johannesburg in South Africa. The plant was commissioned in mid-1985 and has a design capacity to process 200 000 tons of ore per month. Currently, both Reef and waste material from Doornkop shaft is treated at the plant using two milling streams.

The gold plant consists of a Reclamation section (which is designed to receive the ore by overland conveyor, rail and by road trucks), a Milling section for grinding of ore to the required size distribution in order to liberate the gold particles, Thickeners for dewatering (pulp for leach feed), a Leach section for dissolution of gold (using liquid sodium cyanide as one of the reagents), Carbon in Pulp for adsorption of dissolved gold and a recovery section which consists of Elution, Electro-winning and a Smelthouse. All tailings are pumped to a Tailings Storage Facility, adjacent to the plant on the northern side.

The gold extraction technique at Doornkop plant is based on the cyanide leaching process that is followed by the carbon-in-pulp process to recover the dissolved gold from the leach solution. The addition of cyanide at the leach is based on mass-flow and is controlled by a TAC 1000 analyser in order to ensure accurate dosing. A WAD cyanide analyser is installed to analyse WAD cyanide concentration at the tail end of the plant.



***Auditor's Finding***

**This operation is**

**in full compliance**

in substantial compliance \*(see below)

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

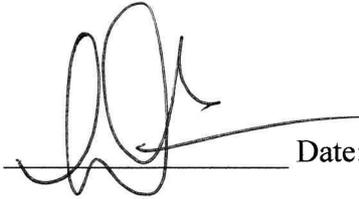
Audit Team Leader: Arend Hoogervorst

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Names and Signatures of Other Auditors:

Name: Dawid M. L Viljoen

Signature



Date: 14 APRIL 2021

Dates of Audit: 7<sup>th</sup> – 11<sup>th</sup> December 2020

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 Mining Operations Verification Protocol and using standard and accepted practices for health, safety and environmental audits.

Doornkop Gold Plant

Facility

Signature of Lead Auditor

16 APRIL 2021

Date

Doornkop Gold Plant

Signature of Lead Auditor

13<sup>th</sup> April 2021

*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 (including Doornkop), in place with Sasol South Africa, as the sole supplier of liquid Sodium Cyanide, delivered by bulk tanker. Sasol South Africa is a signatory to the Cyanide Code and was re-certified as a fully compliant Production Facility with the ICMI (International Cyanide Management Institute) 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:*

A Group-wide cyanide Supply and Transport Agreement covering all Harmony Gold Plants (including Doornkop) is in place with Sasol South Africa as the sole supplier of liquid Sodium Cyanide. The Agreement duration is from 1 January 2019 and terminates

31 December 2022. Sasol South Africa is also responsible for the transport of cyanide solely using Tanker Services Food and Chemicals/Imperial Logistics, an ICMI transporter recertified on 21 November 2018. A Memorandum of Agreement (MOA) for the off-loading of liquid sodium cyanide in terms of SANS (South African National Standard) 10231:2006 and the codes of practice incorporated into legislation and the national Road Traffic Act 93 of 1996 and regulations between Tanker Services Food and Chemicals/Imperial Logistics and Harmony Gold Mining Company (including Doornkop Mine) 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 communications.

The Supply and Transport Agreement does not specify that the designated responsibilities extend to any sub-contractors. However, as the Transporter is a certified ICMI transporter, this section is therefore deemed compliant.

There is no mention of the requirement to add red dye to the liquid cyanide supplied by Sasol in the Harmony Group Agreement. Site procedures do not refer to the addition of dye to the liquid cyanide storage tanks. However, the Safety Data Sheet (SDS), which forms a part of the supply agreement, stipulates in section 9 - physical and chemical properties, that the colour of the product is light to dark red.

*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:*

A Memorandum of Agreement (MOA) for the off-loading of liquid sodium cyanide in terms of SANS (South Africa National Standard) 10231-2006 and codes of practice which incorporate into legislation and the national Road Traffic Act 93 of 1996 and regulations between Harmony Gold Mining Company and Tanker Services Food and Chemicals Division/Imperial Logistics and Harmony Gold Mining Company (including Doornkop Mine) 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. The MOA further confirms that the Transport Operator is accredited with the ICMI and shall adhere to all requirements and procedures required.

There is no mention of the requirement to add red dye to the liquid cyanide supplied by Sasol in the Harmony Group Contract. However, The Safety Data Sheet (SDS), which



forms a part of the supply contract, stipulates in section 9 covering the physical and chemical properties, that the colour of the product is light to dark red.

A full set of chain of custody records including the Harmony purchase order, Sasol invoice, Sasol Certificate of Analysis, Sasol delivery note and Tanker Services delivery note, was sighted. These were sampled for deliveries in 2018 and 2020.

**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 cyanide mixing takes place on site. Original drawings were satisfactorily reviewed during the original certification and are still available. No change has occurred from the previous audit. Sasol, the cyanide producer, inspects the installation annually. Inspections for 2019 scored 90%, and 2020 scored 95%.

The structures are located on concrete and away from workshops and any people, with the control room being the closest area where people are working. The control room windows are sealed, and a fixed HCN (Hydrogen Cyanide) gas monitor is installed in the storage area. The off-loading and storage areas are located away from surface waters and incompatible materials, and built with materials appropriate for use with cyanide and high pH conditions. The pipes material specifications indicate a level 1 (highly resistant) for cyanide and caustic solutions.

The tankers are parked on a concrete surface sealed with bitumen, equipped with a drain hole draining into the cyanide bund area. The interconnected tanks (conical bottomed tanks on legs, installed inside a concrete bunded area) are equipped with ultrasonic level measurement with alarms on the PLC (**P**rogrammable **L**ogic **C**ontroller) in the control room SCADA (“**S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition” – a proprietary control system architecture, comprising computers, networked data communications and graphical user interfaces (GUI) for high-level process supervisory management, including a PLC). Ultra-sonic level indicators are checked monthly by the Instrument Technician. The tanks are located in the open with a ventilation pipe on top of each tank. Cyanide is ordered only when the levels are lower than the specified levels (40%). The cyanide storage is located in a fenced plant area with access control and further inside a fenced



area with gates locked and electronic key control and lock-up safe, in place. The cyanide is stored separately from incompatible materials.

*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 on-site storage tanks. The liquid cyanide off-loading procedure is detailed, spelling out PPE (Personal Protective Equipment) requirements, use of a buddy in the process, and clearly sequenced tasks, including valves and couplings, to prevent spillages and accidental releases during off-loading. The procedure also provides for cleaning of all couplings and flanges and the tanker outer skin, after completion of offloading.

The Sasol Safety Data Sheet (SDS) stipulates that the colour of the product is 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 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 73 cyanide specific procedures, covering both operational and engineering tasks. The TSF (Tailings Storage Facility) is operated using the Mandatory Code of Practice (COP) for Harmony Doornkop Plant Residue Deposit and the Harmony Doornkop Plant Tailings Dam Operating and Maintenance Manual. TSF procedures identify the assumptions and parameters on which the facility design was based,

including freeboard required for safe pond and impoundment operation and the cyanide concentrations in tailings. Routine shiftly, daily, weekly, monthly, quarterly and annual inspection reports, legal inspections, and checklists were sampled for 2018 and 2020 to check the effectiveness of systems and ensure that proactive and reactive management takes place. The frequency of inspections is deemed sufficient to assure, and document, that the operation is functioning within design parameters.

The plant maintenance and inspection schedule include preventative maintenance inspections on cyanide critical equipment using a Planned Maintenance System (PMS) called the DMS 2000 system (**Drumblade Maintenance & Safety**-proprietary software) which was commissioned in July 2009. The DMS 2000 includes all critical cyanide equipment at the TSF and the Plant. A detailed review of sampled PMS Work Orders in 2020 and 2018 indicated that the documents include date of the inspection, the name of the inspector, and any observed deficiencies, the nature and date of corrective actions, and records are retained on the DMS 2000 electronic PMS system. Identified operational inspections deficiencies are also recorded onto a Work Order. All records are retained from the date of the DMS 2000 commissioning.

Quarterly technical inspections with consultants (Jones & Wagener Consulting Engineers) 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. When undertaken, management of change exercises are signed off by safety and environmental officials.

There is a probabilistic water balance in place, and no scenario has been identified where the need has been highlighted to shut down the plant to prevent overtopping as the plant operates as a net user of water. However, the plant will be stopped temporarily in the case of breakdowns or planned shutdowns using standard plant stopping and starting procedures. The plant was designed with bund areas that should contain all spillages during a power outage. The bund areas are equipped with sump pumps that would return the bund contents to the process following restoration of power.

The Plant operates continuously over breaks such as Christmas and Easter with essential employees required to work during periods of labour unrest or other uncertainties such as the Covid-19 pandemic. Any longer term closure that may require decommissioning/decontamination is catered for by the plant cyanide decontamination procedure.

Overtopping of the bunds will flow to the emergency pond, from where spillage could be pumped back to the process. Thus, no emergency power is needed. With regard to the TSF, a report, the Doornkop Return Water Dam Operating and Maintenance Manual, calculated dam capacity and ability to contain 1:200 year extreme storm events and demonstrated more than adequate spare capacity. It is thus concluded that no emergency power is required at the TSF return water dam.

*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:*

The reef ore characteristics have not changed since the previous audit. However, the ore mix changed as the plant is filling up capacity gaps with waste rock dump material. The reef ore and waste are milled and thickened separately. Weekly bottle roll composite samples are tested at the SGS Laboratory (part of the inspection, verification, testing and certification company) in Randfontein. Test reports were sighted, and the results include cyanide consumption, pH, and cyanide concentration in leach. Testwork was done before the changes, to determine the leach characteristics of the waste. The results spreadsheet was sighted, and there were no indications of higher cyanide consumption observed. Currently, the plant leaches at between 250 and 300 ppm sodium cyanide.

The waste rock was depleted at the end of October 2020 and the Plant now only treats fresh underground ore. The reef ore characteristics are the same as before the waste rock was mixed into the plant feed, as the same shaft is used as a feed source.

Ratio control on thickener underflow, coupled with the TAC 1000 cyanide analyser feed and tailings sample results, are used to control cyanide addition. A WAD (Weak Acid Dissociable) cyanide analyser is used on the residue. The current control strategy is working to the satisfaction of the process plant. Bottle roll test results are used to determine cyanide set points in the leach, and no other strategies are being currently considered.

*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 probabilistic (including the natural variability and uncertainty of precipitation and evaporation data) water balance (PWB) for the TSF and for the plant is in place which is updated with actual rainfall data from the TSF and a weather station at the plant. Information is included on rainfall, storm events, and solution deposition.

Quarterly Piezometer readings are taken into account during reviews and considered in recommending pool levels. It is not permitted to store water in the pool on the TSF by design criteria. A TSF stability assessment by Jones and Wagener was conducted in 2019, and no issues affecting the water balance were noted.



The return water dam includes cut-off drains/walls for diverting run-on into the return water dam. This is included in the PWB. Infiltration is deemed negligible. The plant is equipped with stormwater cut-off trenches, and the PWB includes other run-on, with the infiltration deemed as negligible.

Seepage from the TSF is minimal, as the dam is built on the Ventersdorp lava clay layer, as confirmed in the South West Witwatersrand Geology map. No discharges to surface water occur. Seepage from the Plant is also minimal as the plant is equipped with tarred roads, paving and concrete slabs.

The PWB evaluates the impact of power outages. The new return water dam was sized to accommodate in excess of the design storm events, which is the 1:100 year storm event of 105mm, provided sufficient freeboard is maintained. The Doornkop Return Water Dam Operating and Maintenance Manual report calculated dam capacity and ability to contain 1:200 year extreme storm events and demonstrated more than adequate spare capacity was available.

The TSF inspections include inspection and monitoring on a daily, weekly, and quarterly basis. It was also confirmed as an item in the weekly inspection by the Foreman, including the return water dam levels. Plant surge ponds are used for process water storage, as well as surge for rainfall. Ponds are inspected on a shift frequency.

The freeboard requirement for Doornkop TSF is 1.85 m for the reporting period of 2019. This is based on legislation which requires adequate capacity for a 1:50 year 24hr rainfall event, plus an additional 800 mm freeboard above the mean operational pool level. The freeboard requirement has subsequently increased by 0.15 m from 2019 to 2020, and the required freeboard going forward is 2.0 m, on the advice of the Consulting Engineers, Jones and Wagner. In the electronic review of the DMS 2000 PMS system, it was confirmed that there were frequent inspections of the water systems, including stormwater trenches, to implement the water balance model.

The TSF operating practices (including design assumptions on precipitation) are reviewed and revised, as required, during the annual external reporting cycle. The water level rise associated with individual storm events is re-calculated annually for the TSF based on a current survey of the dam basin while assuming that no water is being decanted during the storm event.

*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 on-line WAD 1000 monitoring results from the tailings tank were reviewed for the three years since the last recertification to check for exceedances of the 50 mg/l WAD cyanide limit. In 2018, there was one exceedance of 59 mg/l. On investigation, it was



found to be a faulty TAC 1000 (16 August 2018). In 2019, there were no exceedances that occurred. In 2020, there was one exceedance of 65 mg/l, which, on investigation, was found to have resulted from a minor spillage (19 February 2020). The surge ponds are operated at cyanide levels below 50 mg/l WAD cyanide. The file and values from the plant surge ponds were reviewed and all values were less than 0.5 mg/l WAD cyanide.

A WAD cyanide analyser is installed, taking samples from the tailings tank, pumping to the TSF. The samples are analysed every 12 minutes, spot values are recorded, 2 hourly, by the control room operators, logged, and inputted into a spreadsheet. A screen alarm on the SCADA is shown at 45 ppm with a red alarm at 50 ppm.

Daily wildlife inspections are conducted on the TSF, and there have been no wildlife mortalities reported since the last recertification. This was verified by sampling TSF inspection records and from an interview with the Intasol TSF Site Manager. This indicates that the current cyanide levels appeared to be effective in preventing significant wildlife mortalities. There is no heap leach operation on site.

*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:*

The Plant is a "no discharge" operation in terms of its legal permits. The Geohydrological study undertaken for the Doornkop tailings facility and the shaft complex concluded that cyanide (total and WAD cyanide) was analysed for and not detected and there are thus no concerns with cyanide. No changes have occurred since the last recertification audit.

Samples are taken from the Klip River Tributary upstream. Values sighted since the last re-certification audit are less than limits of detection, indicating that there are no indirect discharges to surface water due to seepage from the return water dam.

Groundwater samples are taken downstream of the TSF and return dam, and the values are at less than levels of detection. This indicates no indirect discharges due to seepage from the TSF occur.

*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*

There are no specific beneficial uses identified, but seepage management practices are in place. However, the mine chooses to use 0.5ppm WAD and Total cyanide as the limit for groundwater levels. The plant is equipped with tarred roads, concrete slabs, bund walls and brick paving, reducing the seepage to groundwater in case of any spillage. The TSF is designed with underdrains draining to the return water dam. The pool is controlled as per the TSF Code of Practice (COP), and a penstock is used to remove water from the pool, and it drains into the return water pond. The return dam wall is equipped with drain pipes, and any seepage is returned to the main dam. No scavenging boreholes are used. The return water dam is unlined but reported to be on a clay base.

Monitoring boreholes are in place and sampled six monthly. All samples are analysed for WAD cyanide. The borehole sampling map was reviewed, and sample values were checked since recertification. The boreholes cover upstream and downstream of the plant and TSF and all values are less than 0.5mg/l WAD cyanide (all reporting at the limits of detection). The mine does not make use of backfill.

*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:*

There were no changes since the previous re-certification audit. The cyanide storage, leach, CIP (Carbon in Pulp), elution and residue tanks are all placed inside concrete bund areas. The Cyanide storage tanks and Residue tanks are of a conical design type and placed inside concrete bunds. The CIP tanks are flat bottom tanks and installed on raised solid concrete civil foundation (confirmed drawings during original certification audit), inside a concrete bund. The elution tanks are placed on concrete plinths. The Leach tanks are flat bottomed, installed on a solid concrete civil foundation. The evidence during the original certification audit stated, " base design is a solid design and not ring beams - sighted civil drawing...".

The cyanide sump pump returns any spillage to the leach circuit in the leach feed (the pump has a manual start/stop operation), the leach sump pump returns spillage to the leach circuit, the CIP sump pumps return spillage to CIP tanks, the residue sump pump returns spillage to the residue tank, and the trench pump returns water to the CIP tanks.

All secondary containments are sized to hold a volume greater than that of the largest tank and any piping draining back to the tank and the design storm event. All plant pipelines inside the plant are placed above a concrete surface, with shiftly inspections being conducted on the pipelines. Reagent strength pipelines are polypropylene lines and are placed inside secondary containment with any leaks draining back to the cyanide



bund or leach bund. The residue pipe between the plant and the main valve station to the ring main is located inside an earthen trench. The TSF line is placed on the DMS 2000 PMS where inspections are scheduled. All TSF pipelines are rubber lined as an additional spillage prevention measure. The TSF contractor inspects the ring main pipeline and valves and reports to plant management, and the Foremen inspects the pipeline weekly, with Security inspecting TSF pipelines after hours. No pipelines are presenting a risk to surface water as there are no stream crossings in proximity to freshwater dams. Cyanide storage tanks are constructed of mild steel as per design drawings, pipelines are constructed of polypropylene and schedule 40 steel lines, compatible with cyanide and high pH conditions.

*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:*

No significant plant cyanide facility addition or modifications have been made since the original certification audit. The plant is approximately 30 years old, and original Quality Control / Quality Assurance documentation was not available.

However, "Fit for purpose" visual inspection reports, carried out every two years by a Professional Engineer were sighted. The reports identify items that require repair and classifies them as "Emergency Repair" – Potential for serious damage, should be done within 12 months, "Repair" – to be repaired to original condition before maintenance can commence, should be done within 24 - 36 months, and "Maintenance" – Preventative and corrective should be done on a continuous basis. The May 2018 report indicated that no emergency repairs were required for the high strength cyanide facilities. Some work was required in the category "Repair" and the Professional Engineer noted that this was ongoing. In the June 2020 report, the same classification as mentioned above in the 2018 report was used. Once again, no emergency repairs were required for high strength cyanide facilities. The Plant Engineer continues to incorporate repair recommendations into his rolling repair and maintenance schedules.

The latest TSF quarterly inspection concludes, "...The TSF is in a generally good condition, and no major concerns are raised. The phreatic levels remain low, and an additional 1 piezometer has been damaged. Freeboard has been measured to be above legal requirements for the reporting period. The average slurry densities were above targets with isolated cases falling below target, which does not raise any concerns."

*Standard of Practice 4.9: Implement monitoring programs to evaluate the effects of cyanide use on wildlife, surface and groundwater 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 sampling locations, sample preservation, chain of custody procedures, cyanide species sampling and documenting of sampling conditions) 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 downstream of the plant. Surface water samples are taken weekly by laboratory personnel and borehole sampling is done quarterly by the environmental department, and wildlife is monitored daily on the TSF for any mortalities. Monitoring frequencies are conducted at frequencies deemed adequate to characterize the medium being monitored and to identify changes in a timely manner.

**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 Procedure for cyanide facilities in Doornkop Plant and TSF is in place covering all the cyanide equipment on the plant and any relevant cyanide equipment on the TSF- "...to achieve full legal compliance in terms of relevant Health, Safety and Environmental legislation and to obtain a closure certificate issued by the Director of Mineral Development.". This includes an implementation sequence schedule for decommissioning activities. The procedure includes a review requirement when operations have changed, when there is a change in closure planning, or every 5 years.

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



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**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 Closure Cost Report for Harmony Gold Mining Company Limited dated June 2020, indicates an allocation of R619,724.00 (South African Rands) for third party cyanide decommissioning for Doornkop Mine. The cyanide decommissioning costs were developed by a reputable Cyanide Cleaning Specialist. Closure cost estimates are updated on an annual basis as per legal requirement.

The Harmony Gold Environmental Trust Fund financial statements for the year ending 30 June 2019 signed by Auditors, PriceWaterhouseCoopers, on 23 June 2020, include a general rehabilitation provision (which includes cyanide decommissioning). Members of the Trust are Harmony Gold Mining Company mines. Accounts signed by the trustees Melanie Naidoo Vermaak on 1 July 2020 and by trustee, “Neil” on 2 July 2020. The accounts were also signed by Hendrik Odendaal, registered auditor of PricewaterhouseCoopers Inc on 23 June 2020. This Trust Fund is established by legal requirement in terms of the South African Minerals and Petroleum Resources Development Act.

**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 73 cyanide specific procedures, covering both operational and engineering tasks. The procedures include the necessary Personal Protective Equipment (PPE) required and the appropriate pre-work checks and inspections. The TSF (Tailings Storage Facility) is operated using the Mandatory Code of Practice (COP) for Harmony Doornkop Plant Residue Deposit and the Harmony Doornkop Plant Tailings Dam Operating and Maintenance Manual. TSF procedures identify the assumptions and parameters on which the facility design was based, including freeboard required for safe pond and impoundment operation and the cyanide concentrations in tailings. Routine shiftly, daily, weekly, monthly, quarterly and annual inspection reports, legal inspections, and checklists were sampled for 2018 and 2020 to check the effectiveness of systems and



ensure that proactive and reactive management takes place. The frequency of inspections is deemed sufficient to assure and document that the operation is functioning within design parameters.

The plant maintenance and inspection schedule include preventative maintenance inspections on cyanide critical equipment using a Planned Maintenance System (PMS) called the DMS 2000 system (Drumblade Maintenance & Safety-proprietary software) which was commissioned in July 2009. The DMS 2000 includes all critical cyanide equipment at the TSF and the Plant. Quarterly technical inspections with consultants (Jones & Wagner Consulting Engineers) 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. When undertaken, management of change exercises are signed off by safety and environmental officials.

Worker input is covered through the involvement of workers and Safety Representatives in daily toolbox and green area meetings and weekly safety meetings. All procedures are also signed off by a Trade Union Representative / fulltime Health and Safety representative who is a representative of the workforce.

*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:*

In the plant, pH is measured on the leach feed and in the residue and results included in daily log sheets. The pH is controlled at 10.5, which is the norm for Witwatersrand ores, and this is backed up by lime titrations taken on shift every 2 hours. Slaked lime is added to the thickener, which has automated pH control, using on-line pH measurements.

Fixed Polytron cyanide gas monitors are installed at the cyanide storage area, the leach dosing point and the CIP. There is one handheld PAC7000 cyanide gas monitor in the control room and one PAC7000 cyanide gas monitor in the smelt house, there is one PAC7000 cyanide gas monitor at Engineering, one PAC7000 cyanide gas monitor at the Training Department, one PAC7000 cyanide gas monitor at the TSF, and two units in the Emergency Room. Calibration records for fixed and personal HCN gas monitors were sighted for 2019 and 2020. The mine has a maintenance and calibration contract with the manufacturer of the fixed and portable gas monitors to ensure appropriate maintenance and calibration. The locations of the fixed Polytron cyanide gas monitors reflect potential "HCN gas hotspots". Annual hot spot gas surveys were carried out by the Occupational Hygienist. Results for 2019 and 2020 were reviewed, and no HCN gas readings were recorded.



Procedure DKP 79 specifies that the A1 warning alarm value is 4.7 ppm and can be acknowledged. The causes of this triggering must be investigated. The A2 alarm value is 10ppm and cannot be acknowledged and signals that the area must be evacuated immediately.

Safety showers and associated eyewash baths are located at appropriate places throughout the plant and inspected weekly. The use of dry powder fire extinguishers was confirmed during site inspections. Fire extinguishers are checked monthly and before off-loading and annually by specialist contractors.

The cyanide dosing and piping system is colour coded for cyanide. The direction of flow is clearly indicated. The plant uses a pipe colour coding system, and staff are trained on the colour coding. Cyanide storage tanks are also clearly labelled. Pipe colour coding boards were noted during site inspections. TSF slurry line and return water lines are labelled, warning of poisonous water. During the site inspection, warning signs throughout the plant were sighted, which included warning that cyanide is present, no eating, drinking, smoking, open fires, and requiring PPE. Similarly, warning signs are located at the bottom TSF fence at regular intervals as well as around the return water dam. Eating and drinking is only allowed in designated areas, and this is included in the induction and refresher training. Safety Data Sheets (SDSs) and cyanide safety and first aid information (in English, the language used on site by the workforce) was sighted during the site inspection. The SDSs included reference to the colour of the liquid sodium cyanide, light to dark red. 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:*

It was confirmed during the site inspection, that potable water, medical oxygen, a manual resuscitator, and Tripac antidote kits are available. Emergency communication is done via radio, backed up with a man down alarm (at off-loading) sounding in the control room. Risk assessment did not identify the need for any cyanide emergency equipment at the TSF. If necessary, the plant will provide assistance. Contact from the TSF to the plant control room is primarily via radio or cell phone.

Emergency Tripac antidote kits are available at off-loading, leach, smelthouse, and the cyanide emergency room. An Emergency cabin is equipped only with cyanide emergency equipment. All Tripacs are stored in fridges as per the manufacturer's guidelines. There is a PMS (Planned Maintenance System) weekly cyanide safety equipment check and weekly checks of cyanide antidote. The safety officer independently inspects the plant cyanide antidotes and also inspects cyanide equipment monthly at the hospital. Cyanide

antidote replacement is done via orders placed with the pharmacy at Lenmed Randfontein Private Hospital, based on reminder triggers from the PMS system.

The gold plant has a Doornkop Gold Plant Surface Operations / Emergency Procedures Emergency Response Plan and Intasol, the TSF contractor, has its own emergency response plan. The Doornkop Tailings Code of Practice also includes TSF emergency preparedness and responses.

The emergency team is trained in the emergency plan and the administering of oxygen. Antidotes are applied only by professional medical staff trained in cyanide first aid. A Netcare 911 ambulance is stationed at the mine clinic across the road from the plant, and the ambulance paramedic staff are trained in cyanide emergency first aid, as well as in cyanide awareness. There is an Agreement between Harmony Gold Mining Company and Lenmed Randfontein Private Hospital regarding the provision of hospital services of cyanide patients and the management thereof relating to Doornkop Mine. The agreement will be for an indefinite period but may be terminated by either party giving one months' notice. Harmony uses its contracted EMS (Emergency Medical Services) Netcare 911 for transportation of patients to Lenmed Hospital.

Full cycle drills conducted from plant to hospital include cyanide spillage during off-loading, man down: solution exposure as well as gassing. The drill file was reviewed, and drill reports (including deficiencies and corrective actions) on a gassing mandown in October 2020; Cyanide Splashing mandown in May 2020; cyanide gassing mandown in October 2019; and cyanide gassing mandown in February 2019 were reviewed. Drills conducted from 30th of March 2020 are affected by the Covid-19 regulations with precautions such as social distancing and restricted hospital visits having to be observed during drills.

***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 plan. Intasol, the TSF contractor, has its own emergency response plan. The Doornkop Tailings Code of Practice also includes TSF emergency preparedness and responses. The emergency preparedness plans combine existing procedural responses and emergency provisions to deal with the various scenarios.

Transport-related emergencies are the responsibility of Tanker Services, the ICMI certified transporter. Plans and associated documents include: - provision for evacuation of site personnel and affected communities; dealing with spillages and containment of releases; monitoring, and assessment and mitigation.

*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 Plan process through induction training, safety meetings, training and emergency drills. The community is not directly involved in the Plan but is informed on its contents during dialogue sessions. Drills are used to involve hospital and ambulance staff in planning, response and review processes. The requirement for drills at least twice per year is included in the agreement between Harmony and Lenmed Hospital as part of the involvement of the medical provider in the Doornkop emergency response.

*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 Plan (ERP) details 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 only external outside entities with designated roles in the ERP are the hospital and ambulance service and they are involved in mock drills. The emergency equipment inventory was checked, and site inspections confirmed availability and readiness. The Plan includes contact references (telephone, and cell phone) of internal and external resources for the various scenarios, particularly with detail where external resources and skills might be needed. Also identified are the Emergency Response Team and their training requirements. All staff are trained to handle cyanide emergencies, the ERP defines the roles of the 1st, 2nd, 3rd, 4th responders and the control room operator. 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 Plan includes 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 Plan.

*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, and environmental incident reporting, as appropriate to the site-specific identified scenarios. Use of neutralization processes and materials is clearly covered, as is the disposal of contaminated materials and the use of treatment chemicals such as ferrous sulphate, hypochlorite and hydrogen peroxide in surface water which is prohibited, unless there is a direct threat to human life.

*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 Plan is required to be reviewed annually, following incidents and emergency drills or when new information regarding cyanide becomes available. Reports on various drills, included a cyanide spill and cyanide related injury, were 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 staff entering the plant, including security and contractors, receive e-learning based cyanide basic training which includes cyanide first aid. The training matrix includes all staff requiring cyanide training. Refresher training is given annually on return from leave, using the Wednesday training shift system. This was confirmed during interviews with employees. The system flags staff with expired training requiring refresher training. The e-learning system blocks the entry cards to the Plant if refresher training is not completed successfully. 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 the life of the plant in the e-learning system.

*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:*

Employees are trained using the Standard Task Procedures (STPs) during on-the-job training. The area-based task matrix displays the procedures along the y-axis and along

the x-axis lists the departments in the plants and which procedures are relevant to each department. The departments identified are CIP, Mills, Engineering, Laboratory, Smelthouse, Relining, Security and TSF. TSF operations staff receive job-specific training based on safe work procedures.

The training is provided by the Plant Training officer who is a qualified MQA (Mining Qualifications Authority) Training Assessor. Her certificates include: -Assessor Learning Program to conduct outcome-based assessment, a Certificate for Facilitating Learning using a variety of given methodologies (unit standard 117871), and Coach the Learner Program (unit standard numbers 117877, 123393 and 114878). TSF training is provided by the Intasol Trainer, who is a qualified MQA Training Assessor. He has a Human Resources diploma, HRD (Human Resources Development) Diploma, a Management certificate, and a Master of Business Administration qualification.

The training system uses a matrix to ensure that all cyanide personnel are trained prior to starting work in the cyanide areas. Metallurgical plant induction is a prerequisite to get access through the card access control system. Formal assessments are done by a qualified Assessor before an employee commences a new job. The workbook system is used, and a workbook was sampled covering adsorption initial development. The book includes details of training undertaken, supervised practical exposure, practical assessment, progress meetings, and panel assessments.

Task-based refresher training for both the TSF and the Plant is undertaken when PTOs (Planned Task Observations) identify a problem or deficiencies. PTOs for both the TSF and the Plant were sampled and reviewed for 2018 and 2020.

STP training records are kept in hard copy form for the employees and filed under the section and the individual. Any training done via the e-learning system is kept on electronic record for the life of the plant.

*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 cyanide section employees are trained in the cyanide emergency procedures, including cyanide release and cyanide decontamination scenarios. This is done during the induction and refresher courses. All cyanide section employees, cyanide specialists and cyanide maintenance staff are trained in advanced cyanide rescue and first aid, including the first, second, third, fourth responder system and use of emergency response equipment. On-site cyanide training by Sasol, the cyanide producer, for the key staff working in cyanide areas, is done annually.

A service level agreement is in place with Lenmed Randfontein Private Hospital, which is equipped to treat both cyanide gas and liquid exposure cases. The plant safety officer

inspects the hospital cyanide emergency equipment monthly. Training arrangements with the hospital are in place, and Hospital and Netcare 911 (ambulance) staff are involved with the emergency drills to test and confirm arrangements and plans. Training records for hospital and ambulance staff were reviewed covering 2018 and 2019. Training for 2020 has been delayed due to the Covid-19 pandemic. Community members are not involved in the emergency response plan. Periodic mock cyanide drills are undertaken, and training personnel attend these drills and formally evaluate response and performance. A cyanide spill drill in the form of a PTO on the Procedure -Use of Ferrous Sulphate was carried out on 19 June 2019. The result was the candidate followed to task steps accurately and understood the procedure task steps. Refresher training is done annually. Any training done via the e-learning system is kept on electronic record. Printouts of electronic training records demonstrating record-keeping and course descriptions using Harmony training categorisations were sighted. The training files of personnel interviewed were sampled, and training records confirmed.

***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 program with the schools continues to highlight dangers of children entering and playing on Mine property, in particular the TSF and the Return Water Dam. Although presentations were limited in 2020 due to the Covid-19 pandemic, safety awareness campaigns were presented at Onkgopotse Tiro Primary School on the 13 November 2018 (approximately 150 learners and 7 Teachers) and 12 March 2019 (5 teachers). A presentation was also made at Slovoville Primary School (200 learners). Meetings and interactions with Community Leaders and Councillors have been difficult owing to tensions regarding jobs and procurement. These tensions have caused non-cooperation with regard to meetings.

*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 program with the schools continues to highlight dangers of children entering and playing on Mine property, in particular the TSF and the Return Water Dam. Although presentations were limited in 2020 due to the Covid-19 pandemic, safety awareness campaigns were presented at Onkgopotse Tiro Primary School on the 13 November 2018 (approximately 150 learners and 7 Teachers) and 12 March 2019 (5 teachers). A presentation was also made at Slovoville Primary School (200 learners). Meetings and interactions with Community Leaders and Councillors have been difficult owing to tensions regarding jobs and procurement. These tensions have caused non-cooperation with regard to meetings.

*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:*

Copies of presentations are given to teachers during the various school meetings. Examples of presentations were sighted, such as, "No matter the circumstances, safety is our main priority". A Safety and Environmental Awareness Poster subtitled, "Dangers of a waste rock dump, Slimes dam and Return water dam" was sighted which included photographs illustrating potential hazards of drowning in slurry, drowning in return water dams, dangers of large trucks and loaders on the rock dumps, and the risks as a result of stealing fencing and signage and damaging pipeline infrastructure (also resulting in cyanide poisoning).

Literacy is not a significant problem; however, local languages, such as Xhosa and Tswana, are used for presentations to improve understanding. The presentations are, however, prepared in English and translated into local languages verbally.

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. Information on significant cyanide exposures would be made available, after appropriate



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investigations, on the company ESG (Environmental, Social and Governance) website (<http://www.har.co.za/20/> ) and via the annual Sustainable Development Report, or through the Harmony company website at <https://www.harmony.co.za/responsibility>. Government Departments do not make cyanide (or any other) releases publicly available in all cases. Harmony will investigate all cyanide releases and include reports on them in their annual Reports.

