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for a better  
*future /***

Porgera Joint Venture

**International Cyanide  
Management Code**

ICMC Pre-operational Audit  
Porgera Gold Mine -  
Summary Audit Report

wsp

January 2024

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## International Cyanide Management Code ICMC Pre-operational Audit Porgera Gold Mine - Summary Audit Report

Porgera Joint Venture

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	Name	Date	signature
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Reviewed & Approved by:	Ed Clerk	08/09/2023	

WSP acknowledges that every project we work on takes place on First Peoples lands.  
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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# 1 Summary Audit Report

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## 1.1 For Operational Gold Mines

<b>Name of Mine:</b>	Porgera Mine
<b>Name of Mine Owner:</b>	Porgera Joint Venture
<b>Name of Mine Operator:</b>	Barrick (Niugini) Limited (BNL)
<b>Name of Responsible Manager:</b>	Enzo Guarino – Manager Environment, Barrick Niugini Ltd
<b>Country:</b>	Papua New Guinea
<b>Telephone:</b>	+675 544 3146
<b>Email:</b>	fiorenzo.guarino@porgerajv.com

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## 1.2 Operation Location Detail and Description

### 1.2.1 *Porgera Joint Venture*

The Porgera Joint Venture (PJV) owns the Porgera Mine which is operated by Barrick (Niugini) Limited ("BNL") on behalf of the JV partners. BNL owns 95% of PJV while the remaining 5% is owned by Mineral Resource Enga (MRE) Limited, which is a consortium between the Enga Provincial Government (2.5%) and the Porgera landowners (2.5%).

BNL is a company incorporated in Papua New Guinea. It is an independently managed company and is jointly owned through an equal partnership between Barrick Gold Corporation ("Barrick") of Canada (47.5%) and Zijin Mining Group Company Limited ("Zijin") (47.5%) of China.

### 1.2.2 *Porgera Gold Mine*

The Porgera Joint Venture (PJV) is an open pit and underground gold mine located at an altitude of 2 200-2 600 m in the Enga Province of Papua New Guinea (PNG), about 600 km north-west of Port Moresby and 680 km from Lae, the port of entry for most of the mine's supplies. The mine is situated in rugged, mountainous terrain on the floor of the Porgera Valley, which rises to 2,800 m at the rim. The annual rainfall is approximately 3.7 m and daily temperatures range from 10°C to 25°C.

### 1.2.3 *Operation*

The operation has been on care and maintenance since April 2020. The major components of the Porgera Processing Plant include:

- Crushing circuit and coarse and fine ore storage
- Grinding circuit
- Gravity and regrind circuit
- Flotation circuit
- Pressure oxidation and tailings neutralisation circuits



- Leaching and adsorption circuits
- Acid wash and stripping elution circuit
- Electrowinning and gold refinery
- Oxygen plant
- Reagent storage and mixing
- Cyanide destruction plant
- Tailings pipework and infrastructure
- Solid cyanide briquettes is delivered in sea containers by truck to site

The following cyanide facilities were included in the scope of this Recertification Audit:

- Flotation circuit
- Pressure oxidation and tailings neutralisation circuits
- Leaching and adsorption circuits
- Acid wash and stripping elution circuit
- Reagent storage and mixing
- Cyanide destruction plant
- Tailings pipework, infrastructure, and riverine discharge
- Incineration.



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## 1.3 Auditors Findings

The PJV Gold Mine is:

in full compliance with

in substantial compliance with

not in compliance with

**The International  
Cyanide Management  
Code**

No significant cyanide incidents or cyanide exposure and releases were noted as occurring during the audit period.

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## 1.4 Auditor Information

Audit Company: WSP Australia Pty Ltd (WSP)

Audit Team Leader: Rudi Seebach (ICMI Lead Auditor)

Email: [rudi.seebach@wsp.com](mailto:rudi.seebach@wsp.com)

Name and Signature of other Auditors:

Table 1.1 Name and Signature of Other Auditors

Name	Position	Signature	Date
Rudi Seebach	ICMI Lead Auditor		08/09/2023
Ed Clerk	ICMI Technical Specialist		08/09/2023

The Pre-operational Audit site visit was conducted between 20 and 22 June 2023.

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## 1.5 Auditor Attestation

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 Pre-operational Audit. I further attest that the Pre-operational Audit was conducted in a professional manner in accordance with the International Cyanide Management Code (ICMC)'s *Mining Operations Verification Protocol* (June 2021) and using standard and accepted practices for health, safety, and environmental audits.



## 2 Principles and Standards of Practice

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### 2.1 Principle 1 – Production and Purchase

#### 2.1.1 *Standard of Practice 1.1*

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

**in full compliance with**

The operation is

in substantial compliance with

Standard of Practice 1.1

not in compliance with

#### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 1.1, requiring the intended operation to purchase its cyanide from manufacturers certified as being in compliance with the Code. Orica Australia Pty Ltd (Orica) has historically supplied cyanide to PJV from its Yarwun, Australia, facility, which was certified as being compliant with the ICMC on 17 September 2020. The Yarwun facility was recertified in full compliance on 31 October 2023. PJV intends to continue with this process.



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## 2.2 Principle 2 – Transportation

### 2.2.1 Standard of Practice 2.1

**Require that cyanide is safely managed through the entire transportation and delivery process from the production facility to the mine by use of certified transport with clear lines of responsibility for safety, security, release prevention, training and emergency response.**

**in full compliance with**

The operation is  in substantial compliance with  Standard of Practice 2.1

not in compliance with

#### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 2.1, requiring that cyanide transporters implement appropriate emergency response plans and capabilities and employ adequate measures for cyanide management.

The operation has provided historical chain of custody records identifying all elements of the supply chain that have previously handled the cyanide brought to its site.

The intended supply chain elements are as follows:

- Orica Australia supply the cyanide from its Yarwun facility, where it travels to the Port of Brisbane under the ICMC certified Orica Australia supply chain.
- From the Port of Brisbane, it is then shipped to the Port of Lae in PNG under the ICMC Orica Global Marine Supply Chain.
- From the Port of Lae, it is then transported to the Porgera mine site by the ICMC certified transporter Mapai Transport Limited (Mapai).

The intended cyanide transporters are certified under the Code.

Orica Australia's Australian Cyanide Transport Supply Chain has been certified in full compliance with the Code since 4/2/2022. Orica Australia's Global Marine Supply Chain was recertified in full compliance with the Code in 16/6/2021. Mapai was certified in full compliance with the Code on 26/4/2017.



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## 2.3 Principle 3 – Handling and Storage

### 2.3.1 Standard of Practice 3.1

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

in full compliance with

The operation is  in substantial compliance with Standard of Practice 3.1

not in compliance with

#### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 3.1, requiring that intended cyanide unloading, storage and mixing facilities are designed and constructed consistent with sound, accepted engineering practices, quality control/quality assurance procedures, spill prevention and spill containment measures.

Facilities intended for unloading, storing and mixing cyanide have been designed and constructed in accordance with sound and accepted engineering practices for these facilities. No changes have occurred to the site since the last recertification audit relating to unloading, storing and mixing facilities.

Solid cyanide is anticipated to arrive at Porgera in sea containers by truck. One container is delivered per truck. The sea container is unloaded from the truck by PJV personnel using a 30 tonne (t) forklift and the container is placed directly onto a hardstand area.

Barrick engaged consultants GHD in 2007 to review the design and construction of the cyanide unloading, storing and mixing facilities at Porgera. This document was sighted but as it had been reviewed and referred to in the 2016 certification audit, it was not reviewed during this audit.

Unloading and storage areas intended for solid cyanide are located away from people and surface waters.

The mixing area is approximately 40m from the main entrance with a permanent security presence. The distance between the unloading, mixing, and storage facilities and the nearby surface waters is approximately 1.5 km. During a cyanide mix the area is barricaded and fixed and portable monitors are used to check for HCN. No instances of elevated HCN have been detected outside the building during a mix.

Cyanide unloading, mixing and storage facilities are contained within secondary containment. Spills within these areas report to sump pumps that direct solutions back to the storage tank (for mixing area) or process areas (for container storage area) not the environment.

Only solid cyanide is intended to be unloaded at Porgera, no tanker truck is involved. Solid cyanide is unloaded from wooden boxes and moved by crane to the Mixing Tank over a concrete surface that would minimise seepage to the subsurface if it contacted water during unloading.

There is a method designed and intended to prevent the overfilling of cyanide storage tanks. The mixing sequence will be initiated using the LCS (Local control system). Both the Cyanide Mixing Tank and Cyanide Holding Tank have level indicators, which are tied into local electronic displays and can also be viewed by the control room operators on the Supervisory Control and Data Acquisition (SCADA) control system.

Mixing of cyanide solution is required when the Mixing Tank low level alarm is activated (i.e. at 11%). Mixing is undertaken in the Mixing Tank in accordance with the Cyanide Mix procedure and the control logic programmed into SCADA.

The Mixing Tank high level alarm state is at 95% capacity, this alarms locally and in the control room where the operator can stop water addition. The volume of the Mixing Tank (24 kL) is intentionally designed to be less than the volume of the Holding Tank (30 kL), so the risk of overfilling is inherently limited.



The Cyanide Transfer Pump (to transfer cyanide solution from the Mixing Tank to the Holding Tank) automatically shuts off when high level is reached in the Holding Tank to prevent overflow.

The level transmitters in the mixing and holding tank are calibrated periodically as part of a routine (PM) preventative maintenance ) conducted by Instrumentation. In addition, the holding tank the level transmitter is wired into the control system. Code exists in the control system to allow a transfer given the right conditions exist, in that the holding tank level is low enough to accept the mixing tank volume.

The intended cyanide mixing and storage tanks are located on a concrete surface that can prevent seepage to the subsurface.

The area where cyanide in solid form is anticipated to be mixed to make cyanide solution is constructed from concrete. The Cyanide Mixing and Holding Tanks stand in a concrete bunded area. Any spillage will be collected inside the bund and can be recovered. The intended secondary containments for cyanide storage and mixing tanks are constructed of materials that provide a competent barrier to leakage.

Barrick engaged consultants GHD in 2007 to review the design and construction of the cyanide unloading, storing and mixing facilities at Porgera. This document confirmed that secondary containments were constructed of materials that provide a competent barrier to leakage. This document was sighted but as it had been reviewed and referred to in the 2016 certification audit, it was not reviewed during this audit.

No changes have occurred to the site since the last recertification audit relating to unloading, storing and mixing facilities.

The Cyanide Exhaust Fan is installed to extract vapours from the headspace of both the Sodium Cyanide Mixing Tank and the Cyanide Holding Tank and to exhaust those vapours to atmosphere above the roof of the Reagent Building.

The cyanide boxes unloading procedure requires containers to be vented for 15 minutes and tested for HCN before unloading cyanide boxes. Historically, sea containers holding unopened boxes of solid sodium cyanide were positioned on hardstand, in an area near the Processing Plant. The containers were positioned on well drained relatively flat ground.

Due to the existence of hardstand at the location and the design of sea containers, it was considered in the previous audit, that the cyanide will be stored under a roof and off the ground and so the potential for contact of sodium cyanide with water under foreseeable circumstances is low.

Up to two boxes of cyanide may be stored in the Reagent Building awaiting mixing. This temporary storage is also under a roof and off the ground. This is what is also expected for the intended operation.

The cyanide sea containers will be kept locked under the control of the Warehouse Department, as per historically approved procedures. The Reagent Building is kept locked under the control of the Processing Plant. Both areas are within the Porgera operational area which is separated from public areas by a patrolled fence that is also monitored by security cameras. The perimeter security arrangements are designed for gold asset security, but also provide a high level of security for cyanide as a result; personnel admitted to the operational area are subject to random searches.

Previously, cyanide solid and reagent was stored away from the hydrochloric acid that is used in processing.

Hydrochloric acid was stored in a separate reagent shed near the assay laboratory on the far side of the Processing Plant from the Cyanide Reagent Building. This is the planned procedure for the intended operation.



### 2.3.2 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.**

in full compliance with

The operation is  in substantial compliance with Standard of Practice 3.2

not in compliance with

**Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 3.2, requiring the operation of unloading, storage and mixing facilities using inspections, preventive maintenance and contingency plans to prevent or contain releases and control and respond to worker exposures.

With respect to empty cyanide containers:

- a. The previous Cyanide and PAX Box Destruction procedure notes all used bags and timber lids are to be placed inside the empty boxes and burnt. The procedure dealing with cyanide container inspection and clean out requires sea containers that have previously been used for storing cyanide to only be used for this purpose. This procedure is intended for use for the proposed operation.
- b. The previous Cyanide and PAX Box Destruction procedure requires bags to be placed in the boxes and disposed in an environmentally sound manner by delivering the combination to the burn pit where they are burnt. The bags are not rinsed. This procedure is intended for use for the proposed operation.
- c. The previous Cyanide and PAX Box Destruction procedure requires bags to be placed in the boxes and disposed in an environmentally sound manner by delivering the combination to the burn pit where they are burnt. The ashes are also disposed of appropriately in accordance with the Open Fire Ashes Disposal procedure. This procedure is intended for use for the proposed operation.
- d. The previous procedure dealing with inspection and cleanout of cyanide containers inspection requires sea containers that have previously been used for storing cyanide to be only be used for this purpose and as a further safeguard, all sea containers are washed out before they leave the site to ensure that they are free of cyanide contamination. This procedure is intended for use for the proposed operation.

The operation has previously developed and implemented plans or procedures to prevent exposures and releases during cyanide unloading and mixing activities such as:

- a. The Cyanide Mix procedure details the steps required to make up a batch of cyanide reagent, illustrating the use of valves, instrumented controls and other equipment with the use of photographs and schematic diagrams. The document describes the steps for establishment of protective measures, initial water charge, manual addition of caustic soda, manual addition of carmoisine dye, charging of the cyanide from a bulk bag using the crane and completion by charging the final volume of water (subject to high level over-ride). Reagent pipes, pumps and valves are covered by weekly and six monthly maintenance inspections. Weekly pump inspections focus attention on glands (as well as barrels and guards). Six monthly mechanical overview inspections also address seals as well as overall deterioration and evidence of leakage.
- b. The Processing – Forklift procedure addresses the handling of containers without rupturing or puncturing. These include requirements to place a ramp at the entrance of the sea container to enable forklift access, following an exact nominated route (that avoids blind spots) on all occasions and carrying only one box at a time.
- c. The Delivering Cyanide to the Cyanide Mixing Shed procedure limits the number of cyanide boxes carried to one and limits the number of boxes stored in the mixing area to two.



- d. The Cyanide Mix procedure requires the operator to hose up any small spillages. If a large spillage the mill foreman or area supervisor is noted.
- e. The procedure for Cyanide Mix requires all operators working on the cyanide mixing platform to wear the appropriate safety equipment:

- Full face respirator
- Elbow length gloves
- Plastic raincoat/trouser combination
- Safety helmet
- Safety boots.

Further, it sets out that the role of the standby person is purely to observe the mixing and loading operation and follow the emergency notification procedure in the event of an emergency. They are not to assist in the work or enter the Reagent Shed.

The mixing operation was observed to be in accordance with the written procedure.

- f. The Cyanide Mix procedure details the steps required to make up a batch of cyanide reagent, including the manual addition of carmoisine dye.

These are also the processes and procedures expected to be implemented in the intended operation.



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## 2.4 Principle 4 – Operation

### 2.4.1 Standard of Practice 4.1

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

**in full compliance with**

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

#### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 4.1, requiring that the operation implement management and operating systems designed to protect human health and the environment including contingency planning and inspection and preventive maintenance procedures.

Written management and operating plans or procedures have been developed for cyanide facilities including unloading, mixing and storage facilities, leach plants, cyanide treatment and disposal systems.

There are no heap leach operations, tailings impoundments, or cyanide regeneration facilities at PJV.

Reviewed procedures are securely stored on the intranet and controlled by the relevant department as well as the Safety Department. Only designated senior personal has been assigned document control authority.

The operation has plans and procedures that identify the assumptions and parameters on which the facility design was based and any applicable regulatory requirements as necessary to prevent or control cyanide releases and exposures consistent with applicable requirements.

Leach training and procedures identify HCN alarm limit and response actions for 5 ppm, 10 ppm, and 24 ppm. The pH limits are described in the pH Trigger Action Response Plan (TARP).

Carbon-in-pulp (CIP) training and procedures identify design concentrations of cyanide in tails stream being transferred to neutralisation/precipitation as 0.5 mg/L. The waste treatment facility (final tails) at the back end of the Neutralisation circuit targets 0.5mg/L Weak Acid Dissociable (WAD) cyanide.

All operational processing set points will be documented in daily instructions, which will be documented by Metallurgists and sent to the operations team. The set points will be captured in log sheets and on process control room white board. These will be reported daily in the Daily Guidelines Report and the Daily Refinery Checks produced by the Senior Metallurgist.

PJV operates under Environment Permits WD-L3 (121) and WE-L3 (91). The operation must also comply with other relevant PNG legislation including the Conservation and Environment Protection Authority (CEPA) Act 2014, the Environment Act 2000 and Environment Act 2002 (amended).

The Environmental Permits and conditions therein are issued in accordance with the Environment Act 2000 and other Environment laws; compliance with the Permits ensures PJV complies with PNG's Environment laws.

The Environmental Legal and Other Requirements Register contains a full list of the applicable legislation for PJV. This register also details how the commitments are documented and addressed, such as the relevant procedures.

The operation has plans or procedures that describe the standard practices necessary for the safe and environmentally sound operation of the facility including the specific measures needed for compliance with the Code, such as inspections and preventative maintenance activities.

Standard Operating Procedures (SOPs) have been developed to detail what is expected of operators when carrying out their daily duties including sampling and inspections when the plant is operating routinely.

SOPs are typically structured with the following sections:

— Purpose



- Frequency of the task
- Skills required
- Equipment required
- Permits/tickets required
- Hazardous materials
- Cyanide safety
- Environmental aspects and impacts
- PPE required
- Method
- Housekeeping
- References
- Assessment
- Appendices
- Document control record.

The operation has developed a Cyanide Management Plan (CMP) which outlines a systematic approach for the responsible transport, handling, use and disposal of cyanide and cyanide contaminated equipment (including process streams containing cyanide). The CMP sets the framework for maintaining awareness and compliance with legal and other requirements pertaining to cyanide, assessing the risk of cyanide related activities; and links in with existing emergency response processes, consultation and communication with stakeholders regarding cyanide risks and training and monitoring requirements. The CMP has been guided by the Principles and Standards of Practice of the ICMC to enable PJV to maintain compliance with the Code requirements.

Detailed procedures have been developed for some maintenance tasks required to manage risks of cyanide exposure or release such as the cyanide mix exhaust fan, cyanide pumps, cyanide inline filters and the cyanide metering system relief valve. Most maintenance tasks are documented within Oracle.

Preventive maintenance programmes have been developed in Oracle for the site and these will be conducted in accordance with the maintenance schedule. In addition to plant specific inspections, general area inspections (look, listen, feel) will also be included within Oracle.

The facility intends to conduct formal, documented inspections weekly in the cyanide related work areas (carbon-in-leach (CIL) and CIP, cyanide detoxification, and Cyanide Reagent Shed). Work orders will be generated for deficiencies identified during the inspections

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

PJV has implemented a Management of Change (MoC) procedure to ensure risks are captured, evaluated, controlled and communicated before changes are implemented.

The MoC system on the PJV intranet was developed by the operation to initiate and assess changes. The system requires the change initiator to select stakeholders for their consultation and involvement in the proposed change. Safety and Environment personnel are selected by default for all changes and cannot be excluded from the consultation and risk assessment of the change.

In addition, PJV developed the IPRO (name of software) system on the PJV intranet to manage capital projects. The IPRO system incorporates a change management process as part of the project approval pathway. As with the MoC system, the change management function within IPRO requires the change initiator to select stakeholders for their consultation and involvement in the risk assessment; Safety and Environment are selected by default. The facility intends to utilise the MoC and IPRO processes during operation.



The operation has cyanide management contingency procedures for situations when there is an upset in a facility's water balance, when inspections and monitoring identify a deviation from design or standard operating procedures, and/or when a temporary closure or cessation of the operation may be necessary.

PJV has incorporated contingency procedures into various SOPs and management plans at the operation. In addition to these SOPs, interlocks are in place to help control potentially adverse effects from abnormal operating conditions.

Examples of abnormal operating conditions include upsets in loss of power, identified leakages and/or emergency plant shutdowns. Contingency procedures have been developed to address these and a variety of other conditions, for example:

- WAD Cyanide Levels to Riverine procedures includes the contingency procedure in the event WAD CN is greater than 0.5 mg/L; a total plant emergency shutdown is required.
- Cyanide Spill Clean-up is the procedure for spillage of cyanide pellets, solution or slurry.
- Cyanide Emergency Response Plan states situations when temporary closure or cessation of operations may be necessary (e.g., fire, civil unrest).
- The Refinery Controlled Shutdown and CIP Circuit Shutdown Procedures CIP outlines situations when shutdown may be required (e.g., power failure) and the process to safely shut the plant down.

A temporary closure or cessation of operations would be managed under the shutdown SOPs, emergency response system using operating procedures to shut down the plant and make safe during cessation of operations.

In addition, all inducted personnel are trained in Field Level Risk Assessment (FLRA) which provides basic risk management principles for responding to hazardous situations for which detailed procedural guidance may not be defined.

The shutdown procedures and emergency response system account for safe cyanide management during long-term shutdowns.

The operation does intend to inspect the following at unloading, storage, mixing and process areas as applicable to the site.

*a. Tanks holding cyanide solutions for structural integrity and signs of corrosion and leakage.*

The structural integrity of tanks is addressed by both the six-monthly mechanical area inspection and the annual program of non-destructive testing. The six-monthly test addresses the visual evidence of deterioration and leakage and the annual program focusses on corrosion.

In addition, the Environment Department carries out monthly lysimeter monitoring program around the various process tanks.

*b. Secondary containments for their integrity, the presence of fluids and their available capacity, and to ensure that any drains are closed and, if necessary, locked, to prevent accidental releases to the environment.*

Maintenance inspections are scheduled to inspect secondary containments. The inspections address the condition of the concrete, the integrity of the bund floor and walls as well as checking for evidence of distortion, spillage or the build-up of crystals.

*c. Leak detection and collection systems at leach pads and ponds, as required in the design documents.*

The Environment Department manage the monthly monitoring of the underliner detection systems in place at the Gold Room Spillage Pond and the CIP spillage pond for WAD cyanide.

*d. Pipelines, pumps and valves for deterioration and leakage.*

The deterioration of pipelines, pumps and valves is covered by preventive maintenance inspections. Weekly pump inspections focus attention on glands (as well as barrels and guards). Six monthly mechanical overview inspections also address seals as well as overall deterioration and evidence of leakage.

*e. Ponds and impoundments for the parameters identified in their design documents as critical to their containment of cyanide and solutions and maintenance of the water balance, such as available freeboard and integrity of surface water diversions.*

For unforeseen circumstances, the Gold Room and CIP Spillage Ponds are kept empty.



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

During operation process operators for the Leach, CIP and Strip areas will inspect inspected these areas daily. Where issues are raised by operators, the locations involved in those issues will be inspected by the relevant shift supervisor to ensure that correct priority is allocated to the issues.

Process supervisors are scheduled to carry out housekeeping inspections on a weekly basis to meet statutory (“274”) occupational health and safety obligations. Auditor’s inspection of the operation indicated that housekeeping was of a generally good standard indicative of inspections being frequent enough to contribute to the management of risks of cyanide exposure and release.

Inspections are documented, including the date of the inspection, the name of the inspector, and any observed deficiencies. The nature and date of corrective actions are also documented. Records are maintained.

274 Inspections and associate safety equipment inspections are documented, including the date of the inspection, the name of the inspector, and any observed deficiencies.

Inspections by maintenance, engineers and Processing Department personnel (apart from the daily routines of process operators) are all scheduled within Oracle. Oracle is also used to record the completion of scheduled tasks along with new entries for repairs identified as necessary from those inspections.

The records show that issues were raised by the inspections, that work requests are raised to address them and that these are then translated to work orders when resources are allocated.

Preventive maintenance programs are implemented and activities documented to ensure that equipment and devices function as necessary for safe cyanide management.

There is a comprehensive program of preventive maintenance that includes appropriate coverage of mechanical and instrumented systems particularly that must function effectively for cyanide management. The program includes tanks, vessels, pumps, fans, pipelines, valves, instruments and secondary containments that form part of PJV’s cyanide facilities.

The frequencies of activities currently scheduled are weekly, fortnightly, three-weekly, monthly, quarterly, half yearly, annually and four yearly. Evidence supports that vessel condition inspections are being conducted on an annual cycle with attention directed towards vessels that are at higher risk.

An annual routine has been instituted to cover thickness testing of cyanide critical pipelines. Regular inspections are undertaken of steelwork and concrete that have been identified as being in a degraded yet acceptable state. Records requested in evidence showed that monthly calibrations on fixed HCN monitors and personal HCN monitors are generally carried out as planned.

Work orders are issued to action the implementation of preventive maintenance tasks and work order numbers are used to track the documents produced as records of inspection works such as condition monitoring assessments that cannot be reported effectively into the computerised maintenance management system.

The operation has the necessary emergency power resources to operate pumps and other equipment to prevent unintentional releases and exposures in the event its primary source of power is interrupted. The emergency power equipment is routinely maintained to ensure functionality during emergencies.

Primary power supply to the site is from gas-fired generators on-site. Gas is supplied from Hides. Emergency power is not considered essential to prevent unintentional releases and exposures, as there are no identified situations in which cyanide inventories can go out of control when power supply is lost.

In an emergency power situation, all drives are automatically shut down. Any restart of the operation would be controlled, with the 14.4 MW of available power allocated to the priorities. Recognised priorities include lighting, the distributed control system and potable water.

The backup power generating equipment is present on-site. Operation of the backup generators is scheduled by the power station maintenance fitter who ensures that each of the six installed backup generators operates for a period in every week.



## 2.4.2 Standard of Practice 4.2

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

in full compliance with

The operation is  in substantial compliance with Standard of Practice 4.2

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 4.2, requiring that the operation introduce management and operating systems to minimise cyanide use, thereby limiting concentrations of cyanide in mill tailings.

During operations new ore types will not be tested for cyanide consumption rates as the blending of ore on the run of mine (ROM) pad, additional blending in the concentrate storage tanks (CSTs) and the oxidisation process in the autoclaves will produce a homogenous feed requiring a relatively constant cyanide addition rate.

The ore will be categorised into five main mineralisation types, which will be stockpiled separately on the ROM pad. The ore will be blended and crushed and conveyed to the coarse ore stockpile from which the ore will be reclaimed and fed to the grinding circuit before being transferred by slurry pipeline to the Anawe plant-site for processing.

Coarse free gold will be recovered using Knelson Concentrators. The remaining slurry will be treated by flotation for the recovery of fine free gold and refractory gold locked in sulphide minerals.

Flotation concentrate produced will be fed into one of six CSTs. Further blending occurs will occur at the CSTs through the selective movement of the product into and out of individual CSTs based on sulphur grades.

The slurry from the CSTs will be oxidised in four autoclaves and directed to the leach circuit consisting of eight agitated tanks. This consists of the conditioning tank where about 1.5 kg of lime per tonne of solids will be added to adjust the pH to 10.5. Sodium cyanide solution will be added in the first leach tank to a level of 230 to 250 ppm. The cyanide addition rate in the CIL will be automatically controlled using Cyantific instrumentation in Tank 1. The addition of cyanide will be automatically stopped if the instrumentation in Tank 1 records cyanide addition flow rates above 25 L/min or the pH in conditioning tank and Leach Tank 0 drops below 9.5. The process operators also perform manual titrations (silver nitrate) for quality purposes.

After the gold has been leached in the leach circuit the slurry will be pumped to a series of nine agitated CIP tanks. Together the CIL and CIP contain 120-130 t of carbon. 10 t of carbon will be forwarded each day to the elution and electrowinning circuit.

The thickener will overflow, and the tailings from the CIP tanks all go to the neutralisation tank via the cyanide detoxification system, to be neutralised before they are discharged to the river. The discharge pH level will be monitored continuously by field mounted probes and is checked hourly along with cyanide levels by operators. The target will be 6.3 to 6.7.

Although new ore types will not be tested for cyanide consumption rates, operational assessments will be conducted using bottle roll leach tests

Tests will include daily diagnostic on CIP tails, daily profile checks and weekly diagnostics on composite samples. Process and operations personnel will also conduct hourly checks on WAD cyanide and pH at the CIL, CIP and Precipitation Tank 2 (tank prior to riverine discharge). The Environment Department will test for WAD cyanide and pH twice per day at the cyanide detoxification tail and Precipitation Tank 2.

The facility did complete a project in 2019 to optimize the use of cyanide in the plant. The project included to improvement in the leach feed density and cyanide control that also considers cyanide soluble gold in the CIP tails to make necessary adjustments accordingly (based on the TARP). The facility included control changes to the Copper Sulphate/ Sodium Metabisulfite dosing as well as in the cyanide detox plant to avoid overshooting cyanide in the tails.



### 2.4.3 Standard of Practice 4.3

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

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 4.3

not in compliance with

#### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 4.3, requiring the operation to implement a comprehensive water management programme to protect against unintentional releases.

The previous operation developed a Mass Balance in 2014 to ascertain the material movements and water transfers around the circuit. The proposed operation is expected to update this mass balance.

The mass balance and water procedures and strategies will be principally aimed at water conservation and reliability rather than the protection against unintentional releases of cyanide solutions.

The intended Porgera cyanide facilities will be a flow through system ultimately discharging to a riverine disposal system at less than 0.5 mg/L WAD cyanide. As no cyanide solutions will be contained outside of process tanks (and associated secondary containments during contingencies), there is no chance of unintentional releases and a probabilistic water balance is not required to protect against this.

PJV engaged Water Management Consultants (WMC) in 2007 to assess Porgera's water balance against Code requirements. In their report, WMC noted that the release of tailings to the wider environment (riverine discharge of tailings) is planned, intentional and fully in accordance with mine permits. The report also noted that there are no fluid impoundments containing cyanide outside of the plant area.



#### 2.4.4 Standard of Practice 4.4

##### **Implement measures to protect birds, other wildlife and livestock from adverse effects of cyanide process solutions.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 4.4

not in compliance with

##### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 4.4 requiring the intended operation to implement measures to protect birds, other wildlife and livestock from adverse effects of cyanide process solutions.

Previously, there were no open water bodies at Porgera with WAD cyanide levels in excess of 50 mg/L, this is expected to be the case under the proposed operation as the same procedures and processes will be in place. As such, it is expected that there will be no requirement under the Code to restrict wildlife access.

In previous audits of the operation, the following water bodies with the potential to contain cyanide were observed at PJV:

- Tailings stream
- Process water pond
- Event spillage pond.

Prior to the commissioning of the Cyanide Destruction Plant the discharged tailings stream contained WAD cyanide averaging between 3 and 5 mg/L. In December 2008, Porgera commissioned a Cyanide Destruction Plant that reduces WAD cyanide levels in the discharged tailings stream to less than 0.5 mg/L WAD cyanide.

WAD concentrations in the tailings discharge for the previous audit period were viewed; the average concentration was 0.2 mg/L. The Process Water pond is upgradient of the site and does not contain tailings water for recovery.

The event spillage pond has the potential to contain cyanide but it is unlikely to be greater than 50 mg/L. Any cyanide in this pond would be a result of an emergency or extreme event would be cleaned up as soon as practicable. Monitoring of this pond will only occur in connection with an event.

In circumstances related to a minor spill in these areas the bunding surrounding the leach circuit is of a sufficient volume to capture any spills in an emergency. It is expected that this will be the case in the intended operation.

Previously, cyanide monitoring results demonstrating that 50 mg/L is not exceeded were reported in the PJV Environment Monthly Report and the PJV Annual Environment Report. This is expected to be the case during the proposed operation.

When previous cyanide operations were occurring, the audit found that the Cyanide Destruction Plant has reduced WAD cyanide levels in the discharged tailings to less than 0.5 mg/L WAD which is effective in preventing significant wildlife mortality. There were no wildlife mortalities reported during the audit period. The operation will not use a heap leach process.



## 2.4.5 Standard of Practice 4.5

### Implement measures to protect fish and wildlife from direct and indirect discharges of cyanide process solutions to surface water.

in full compliance with

The operation is  in substantial compliance with Standard of Practice 4.5

not in compliance with

#### Summarise the basis for this Finding/Deficiencies Identified:

PJV is in FULL COMPLIANCE with Standard of Practice 4.5 requiring the intended operation to implement measures to protect fish and wildlife from direct or indirect discharges of cyanide process solutions to surface water.

The operation will have a direct discharge to surface water, however, it will be less than 0.5 mg/L WAD cyanide, as was the case in the historical operation.

After treatment in the Cyanide Destruction Plant and the waste treatment circuit, the tailings will be discharged into the Porgera/Lagaip/Strickland River system via the Pongema River, as per the Porgera Environmental Permit issued by the PNG Government.

The Cyanide Destruction Plant will reduce WAD cyanide levels in the discharged tailings stream to less than 0.5 mg/L WAD cyanide. WAD concentrations in the tailings discharge for the previous audit period were viewed; the average concentration was 0.2 mg/L.

The Process Department takes two hourly samples of the tails stream and analyses for WAD CN using a Mintek Cynoprobe. Separately, the Environment Department takes twice daily WAD CN samples and analyses using a Mintek Cynoprobe. All monitoring results sighted were below 0.5 mg/L WAD CN.

Despite monitoring results indicating that cyanide concentrations in surface water are below the limits of detection, the operation has implemented controls in order to respond to a potential increase in WAD CN levels in the discharge.

The operation has developed a TARP which contains a range of response actions if WAD CN levels are shown to be above 0.5 mg/L as a result of the two-hourly samples taken by the Process Department. The TARP contains response actions based on a 'traffic light' approach where green is acceptable, amber requires designated responses to be implemented and red requires an immediate stop of the leach feed and detox tails. This process allows the operation to manage their discharge such that breaches of the 0.5 mg/L limit are not exceeded.

Audits based on previous operations established the concentration of free cyanide was below 0.022 mg/L downstream of any established mixing zone.

The tailings discharged into the Anawe erodible waste rock dump flows for 3 km in braided channels across the erodible dump before being discharged into the Pongema River at the toe of the Anawe erodible dump. The Pongema River joins the Porgera River 4 km downstream.

The compliance point (SG3) is located approximately 124km downstream from SG2 and is located on the Strickland River (164 km from site). The compliance point at SG3 is referenced as the end of the designated mixing zone in Porgera's Environmental Permit as issued by the government.

All sites are monitored for free cyanide as part of the operations environmental monitoring program. All monitoring results for the last 12 months were below the limit of detection for free cyanide of 0.005 mg/L.

The intended operation will have indirect discharges to surface water via springs. All the indirect discharges will occur within a 1 km radius of the site and will not result in a concentration of free cyanide in excess of 0.022 mg/L downstream of any established mixing zone.

The 12 identified springs will be monitored for WAD CN twice per month and results from the previous audit indicated that the past 12 months of operations involving cyanide were below the limit of detection for WAD CN of 0.02 mg/L. Of these 12 springs, 3 are upstream of the intended cyanide facilities (based on elevation).

Indirect discharges from the previous operation have not caused cyanide concentrations in surface water to rise above levels protective of a designated beneficial use for aquatic life.



## 2.4.6 Standard of Practice 4.6

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

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 4.6

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 4.6 requiring the operation to implement measures designed to manage seepage from cyanide facilities to protect the beneficial uses of groundwater.

The operation manages seepage by operating the Cyanide Destruction Plant for tailings released to the riverine environment and by maintaining facilities that prevent the seepage of cyanide from the Processing Plant. As there is no tailings storage facility (TSF) at Porgera, there is no requirement to manage seepage from such a facility. Groundwater within the vicinity of Porgera has not been designated a beneficial use by the PNG CEPA. The PNG CEPA, through the Environmental Permit, does not refer to groundwater.

As discussed by WMC in 2007, hydrology of the basin where the operation is situated is dominated by surface water runoff. Known groundwater expressions occur downstream of the operation at various surface water springs. These springs are known to be accessed by the local population for drinking water and other domestic requirements. As such, these springs are determined to have a beneficial use. The Environment Department monitors these springs on a monthly basis for WAD CN to determine if seepage may be impacting these sources. All results reviewed during the audit were below limits of detection.

The Environment Department also takes opportunistic samples from beneath the liner of the process spillage ponds for WAD CN. The results of these samples have so far not returned any WAD CN levels above the limit of detection of 0.02 mg/L. WAD cyanide concentrations in groundwater at the compliance point below or downgradient of the facility are at or below levels that are protective of identified beneficial uses of groundwater.

The Government of PNG has not set a numerical standard for cyanide levels in groundwater at the operation. The operation level has set a limit taken from the Australian Drinking Water Guidelines 6 (Australian Government, 2011) which states that *"based on health considerations, the concentration of cyanide in drinking water should not exceed 0.08 mg/L"*. Monitoring results reviewed for the previous audit period were all below the limit of detection of 0.02 mg/L WAD CN.

The 12 identified springs are monitored for WAD CN twice per month and results for the past 12 months were below the limit of detection for WAD CN of 0.02 mg/L. Of these 12 springs, 3 are upstream of cyanide facilities (based on elevation). The operation uses mill tailing as underground backfill and the potential impacts to worker health and the beneficial uses of groundwater have been evaluated and measures have been implemented as necessary to address them.

The tailings stream contains less than 0.5 mg/L WAD CN before being combined with the backfill at the paste plant. The paste plant is not considered a cyanide facility. Risks to worker health at this plant in relation to the low levels of cyanide have been assessed and deemed too low to pose any issues to workers.

Monitoring of naturally occurring springs in the area (that are considered expressions of the groundwater table) has so far not recorded any results above the limits of detection for cyanide. The WAD Cyanide Levels to Riverine SOP states that in accordance with the TARP the Plant is shutdown based on exceedance criteria which stops flows directed to the Paste Plant as well.

Potential seepage from the operation has not caused cyanide concentrations of groundwater to rise above levels protective of beneficial use. Monitoring of naturally occurring springs in the area (that are considered expressions of the groundwater table) has so far not recorded any results above the limits of detection for WAD CN.



## 2.4.7 Standard of Practice 4.7

### Provide spill prevention or containment measures for process tanks and pipelines.

in full compliance with

The operation is  in substantial compliance with Standard of Practice 4.7

not in compliance with

### Summarise the basis for this Finding/Deficiencies Identified:

PJV is in FULL COMPLIANCE with Standard of Practice 4.7 requiring spill prevention or containment measures for process tanks and pipelines.

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

The cyanide mixing and storage facilities, the CIP/CIL and elution area process tanks, the cyanide destruction facility and the neutralisation circuit tanks have impervious concrete secondary containment bunds, concrete spoon drains and event ponds. The neutralisation and CIL circuits along with the barren solution tank in the gold room area rely on the use of lined event ponds to achieve a 110% secondary containment capacity.

Barrick engaged consultants GHD in 2007 to review the design and construction of the cyanide unloading, storing and mixing facilities at Porgera. This document confirmed that secondary containments were constructed of materials that provide a competent barrier to leakage. The cyanide tanks and containments have not materially change since this time and the calculations are still valid. Secondary containments for cyanide unloading, storage, mixing and process tanks are sized to hold a volume greater than that of the largest tank within the containment and any piping draining back to the tank, and with additional capacity for the design storm event.

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

Barrick engaged consultants GHD to review the sizing of the secondary containment measures associated with cyanide process solution tanks in 2007, they drew conclusions that the secondary containments for the following process areas were in compliance:

- Cyanide Mixing and Storage
- CIL
- Elution
- Carbon Measuring Column
- CIP/CIL Spill Pond.

To provide additional secondary containment volume for the CIP area and the Pregnant and Barren Liquor Tanks the bunds overflow in a controlled manner via spoon drains and a culvert to the event pond.

The secondary containment system of the Cyanide Destruction Plant has sufficient capacity to hold the volume of the reaction tank, any piping draining back to the tank, and additional capacity for the design storm event.

Lycopodium Engineering prepared a detailed calculation that demonstrates that the event pond (3890 kL) has more than adequate volumetric capacity to satisfy Code requirements. Procedures are in place and being implemented to prevent discharge to the environment of any cyanide solution or cyanide-contaminated water that is collected in the secondary containment area.

In reviewing the sizing of the secondary containment measures associated with the cyanide process solution tanks at PJV, GHD has noted that sump pumps are associated with each of bunds for:

- CIL
- CIP



- Elution
- Carbon Measuring Column Area
- Pregnant and Barren Liquor Tanks

By inspection, it was also noted that there is a sump pump in the Cyanide Reagent Building and arrangements for a pump to be used to pump out the CIP/CIL Spill Pond.

The configuration of the Cyanide Area Sump Pump allows it either to be manually controlled or to automatically pump accumulated material back to the Sodium Cyanide Mix Tank provided that is not at risk of overflowing.

The configuration of other sump pumps allows them to be either manually controlled or to automatically pump accumulated material (under sump high level switching) to a tank in the area the fixed sump pumps serves. The event pond has facilities enabling a pump to be placed/removed if required.

In addition, good housekeeping practices are maintained to ensure that the bund capacity is as designed, i.e., there is no significant build-up of storm water, solution or slurry present in the bunds for extended periods of time.

All spillages are recovered/cleaned up as soon as practicable.

The Draining Rainwater Runoff – Anawe Plant procedure is for the controlled release of rainwater from the site bunded area and to reduce the potential for uncontrolled discharges. CIP and CIL are ring beam tanks and have lysimeters installed. These will be monitored monthly during proposed operations. Spill prevention or containment measures are provided for all cyanide process solution pipelines to collect leaks and prevent releases to the environment.

Cyanide, process solution and slurry lines will be contained within secondary containment, concrete bunding and/or concrete drains. Cyanide reagent piping will be jacketed at the locations where it crosses unsealed ground. Weep holes are in place where those jackets are close to the ground level within the bunded areas or the jackets are left open at the discharge point to enable leakage from the inner pipe to be made visible under relatively safe conditions.

Since completion of the Cyanide Destruction Plant, tailings lines outside the secondary containment areas are not classified as cyanide solution pipelines. Cyanide pipelines do not represent a risk to surface waters.

Cyanide, process solution and slurry lines are contained within secondary containment, concrete bunding and/or concrete drains. Spills within these areas report to sump pumps that direct solutions back to process areas not the environment.

Tailings lines outside the secondary containment areas are not classified as cyanide solution pipelines. A TARP (WAD CN @ detox tails) has been developed to prevent tailings solutions leaving the tailings neutralisation circuit above 0.2 WAD CN. Cyanide tanks and pipelines are constructed of materials compatible with cyanide and high pH conditions.

GHD reported that all cyanide solution containing plant are considered to be compliant with the relevant requirements.

Consistent with the materials specifications noted as compliant by GHD, the Cyanide Destruction Plant constructed by Lycopodium for PJV has used carbon steel and HDPE as materials of construction compatible with cyanide solution duties.

#### 2.4.8 *Standard of Practice 4.8*

**Implement quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications.**

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 4.8

not in compliance with

**Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 4.8 requiring the implementation of quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications.



Verification of the quality assurance/quality control (QA/QC) program was undertaken during the original certification audit completed by Golder and in subsequent recertification audits in 2009, 2012 and 2016. The documents provided as evidence during the certification audits were sighted during this audit but were not reviewed.

Modifications to the processing plant were recommended and designed by Lycopodium. These recommendations are being worked through by PJV. All capital projects on site are managed through the IPRO project framework. Projects within IPRO cannot be completed without appropriate Closeout Reports being developed and approved. The Closeout Reports contain the necessary QA/QC documentation, including as-built drawings where appropriate.

Maintenance works underway in preparation for recommissioning are being done by either engineering subcontractors or by PJV engineering staff. Tanks refurbished or replaced by PJV staff are managed using API650 (the IPRO project framework is not used during care and maintenance). Works conducted by subcontractors supported by completion reports and MDR reports.

In January 2018, the operation engaged IMO to conduct a site-based engineering audit of the cyanide system against the Cyanide Code. The audit was the response to an incident, which occurred on 4 November 2017, when HCN levels of 36 ppm were recorded above the Regrind Mill 1 discharge hopper. There were no Cyanide Code non-compliances observed during the audit and recommendations were provided.

The operation also engaged Lycopodium to undertake an engineering audit of the cyanide processes at PJV, which included a site visit in July 2018. Lycopodium produced a report, which included a list of action items.

An AFE was approved for the concept design and costing of 15 action items from the audits of the cyanide process at the refinery circuit. Six action items have been flagged as priority and will be designed and implemented by Quarter 3 of 2019, with the rest completed by the Quarter 4 2019. The first six items include:

1. Sodium metabisulphite and copper sulphate mixing tanks.
2. Electrowinning cells collection tank.
3. Strip vessel drain pumps.
4. Acid wash systems.
5. Final concentrate trash screen installation.
6. Redrafting of Refinery Piping and Instrumentation Diagrams P&IDs.

In addition, Lycopodium recommended the replacement or repair of the existing cyanide destruction tank, which has suffered from significant erosion/corrosion. In response, PJV completed an options assessment and are considering installation of a duplicate tank and repairs to the existing tank.

Since the 2016 Recertification Audit, the operation has initiated several capital projects (and associated change management assessments) within the cyanide facilities:

- Cyanide System Compliance.
- Acacia Solution Rinse.
- Cyanide Destruction Tank Duplication.
- Leach Cyanide Concentration Optimisation.

All capital projects on site are managed through the IPRO project framework. Projects within IPRO cannot be completed without appropriate Closeout Reports being developed and approved. The Closeout Reports contain the necessary QA/QC documentation, including as-built drawings where appropriate.

The records associated with changes to the cyanide facilities note that appropriately qualified personnel have reviewed the QA/QC documentation and confirm that the projects have been built as proposed and approved. The records associated with changes to the cyanide facilities have appropriate QA/QC documentation.



## 2.4.9 Standard of Practice 4.9

**Implement monitoring programs to evaluate the effects of cyanide use on wildlife, and surface and groundwater quality.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 4.9

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 4.9 requiring the operation to implement monitoring programmes to evaluate the effects of cyanide use on wildlife, surface and groundwater quality.

Written standard procedures for monitoring activities have been developed for the intended operations.

The Environmental Monitoring, Auditing and Reporting Plan (EMARP) describes PJV's monitoring, auditing and reporting objectives and the controls implemented to achieve them. The Environmental Management and Monitoring Plan (EMMP) specifically describes site environmental management and monitoring programmes, including tailings, waste rock dumps, water quality, meteorology, hydrology and sedimentation, biodiversity and air.

Numerous procedures have been developed to support the EMMP through the provision of specific instructions for the monitoring programmes. The EMMP is a government CEPA (Conservation and Environment Protection Authority) and MRA (Mineral Resources Authority) approved document. In addition to the EMMP, the operation has developed additional monitoring plans outside of the CEPA and MRA monitoring plan requirements.

During the Care and maintenance period, PJV has developed a Care and Maintenance EMMP which has also been approved by CEPA and MRA. This plan typically has a reduction in monitoring and management commitments commensurate with maintaining a safe and stable environment during the cessation of operations.

The documents form part of the site's Environmental Management System (EMS), which has been ISO14001 certified, and are also contained within PJV's document control system.

Sampling and analytical protocols have been developed by appropriately qualified personnel, which will be used during intended operations.

The site monitoring protocols have been developed primarily by the site Environmental Manager who holds a Post Graduate Degree in Science. Development of analytical monitoring procedures is also undertaken by site Senior Chemists and require approval from the Environmental Manager before they are implemented.

The operation also engages the Commonwealth Scientific and Industrial Research Organisation to peer review their Annual Environment Report, which contains all the scientific information gathered during the calendar year and make any recommendations for improvement.

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

Sampling conditions (e.g., weather, livestock/wildlife activity, anthropogenic influences, etc.) and procedures from the historical operation have been documented in writing, and this is expected to continue in the intended operation.

All field sampling activities are recorded on forms that allow the person undertaking the sampling to comment on conditions that may influence analysis, such as river flow, water and human activity.

There is also a meteorological station associated with the mine, which is operated by Environment Department personnel. The automated station records hourly and is also read manually on a daily basis.

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

Environmental monitoring is regularly reviewed and updated. The EMMP details changes to the monitoring program, including justification, resulting from a review completed after the 2015 Annual Environmental Report. The frequency of monitoring was included in the review.



Surface water monitoring is undertaken monthly, with a higher density at SG3 (currently done weekly but will revert to monthly). Cyanide samples are taken twice daily by the Environment Department and every two hours by the Process Department.

The operation has developed a TARP which contains a range of response actions if WAD CN levels are shown to be above 0.5 mg/L as a result of the two-hourly samples taken by the Process Department. This process allows the operation to manage their discharges. It is anticipated that this will proceed in the proposed future operations.



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## 2.5 Principle 5 – Decommissioning

### 2.5.1 Standard of Practice 5.1

**Plan and implement procedures for effective decommissioning of cyanide facilities to protect human health, wildlife, livestock, and the environment.**

in full compliance with

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

#### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 5.1 requiring the operation to plan and implement procedures for effective decommissioning of cyanide facilities to protect human health, wildlife and livestock.

The intended operation has developed written procedures to decommission cyanide facilities at the cessation of proposed operations.

PJV has developed two primary documents, which outline the requirements for the decommissioning of cyanide facilities. These are the Mine Closure Plan (MCP) and Cyanide Decontamination and Decommissioning Plan (DDP).

The DDP is for the decontamination and decommissioning of the Processing Plant and associated infrastructure. A specific procedure is planned to be developed to match the DDP.

The MCP outlines rehabilitation and closure measures for the Gold Mine during operation and at closure. The DDP includes an implementation schedule for decommissioning activities and the MCP includes a high level mine closure schedule.

The DDP schedule is divided into monthly units and the planned tasks are scheduled up to 24 months prior to closure and continue for up to 24 months after closure. The MCP schedule includes the year and indicative major closure milestones.

The operation will review its decommissioning procedures for cyanide facilities during the life of the operation and revise them as needed, as per previous operations.

Within the DDP it is stated “*the Decontamination and Decommissioning Plan will be revised/updated periodically as part of the review and update of the operations Mine Closure Plan. The plan will be assessed and modified to suit changes related to the Closure, Decontamination, Decommissioning and Dismantling activities.*”

The MCP commits to the periodic review of closure criteria and costs based on improved knowledge or changes circumstances.

Both the DDP and MCP were most recently revised in 2018. Safety, Processing and Environment Departments all undertake a review for each revision.



## 2.5.2 Standard of Practice 5.2

**Establish a financial assurance mechanism capable of fully funding cyanide-related decommissioning activities.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 5.2

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 5.2 requiring the operation to establish an assurance mechanism capable of fully funding cyanide related decommissioning activities.

The operation has developed an estimate of the cost to fully fund third party implementation of the cyanide-related decommissioning measures as identified in its site decommissioning or closure plan.

The current estimate closure costs for overall site closure were updated in October 2018 and are \$136.5 million (M) US Dollars (USD). Overall closure costs based on life of mine are calculated at \$158.5M USD. Cyanide decontamination is included within this overall closure cost estimate.

Cost estimates are updated annually by SRK Consulting. Costs are developed and tracked in the Standardised Reclamation Cost Estimator (SRCE). Costs within this document are for third parties to conduct the work. The SRCE spreadsheet was reviewed to ensure the total allocated to cyanide decommissioning included actions outlined in the DDP.

The operation does review and update the cost estimate at least every five years and when revisions to the plan are made that effect cyanide-related decommissioning activities. Cost estimates are updated annually by SRK Consulting. The updates include a site visit by SRK to visually observe the site, with the revision of the SRCE and provision of a memo outlining the changes. Cost estimates are reviewed internally by PJV and approved prior to acceptance. No financial mechanism is required for the operation.

The Porgera operation was permitted in 1989. The Mining Act at this time did not contain a provision allowing the PNG Department of Mining to establish a financial mechanism for closure or decommissioning. In 1992, the Independent State of PNG revised the Mining Act and Regulation. Section 150 (security) of the Mining Act 1992 creates a provision for PNG Department of Mining to impose a Security for all tenements granted for compliance with the provision of the Act. Section 172 of the Mining Act 1992 implies that the arrangements existing under the original Mining Act are not abated under the new Act. Consequently, Porgera is not required to arrange for a Security to be paid.

The operation has established a mechanism of self-guarantee to cover estimated costs for the cyanide-related decommissioning activities as identified in its Decommissioning and Closure Strategy.

The guarantee for Barrick and Zijin are sufficient to cover the Decommissioning and Closure Strategy. A financial strength capacity statement from PWC was provided which confirms that the operating company has the financial strength to decommission all cyanide facilities as costed by a third party.

The guarantee for Barrick and Zijin are sufficient to cover the Decommissioning and Closure Strategy. A financial strength capacity statement from Ernest and Young was provided which confirms that the operating company has the financial strength to decommission all cyanide facilities as costed by a third party. The operation has established self-guarantee as a financial assurance mechanism. The operation has provided a statement by a qualified financial auditor that it has sufficient financial strength to fulfil this obligation as demonstrated by an acceptable financial evaluation methodology.



The ownership structure of PJV is Barrick Gold (Barrick) and Zijin Mining Group each owning an equal stake in the operation. Both companies have provided financial statements that they hold the required funds for cyanide decommissioning activities.

Independent financial auditor, Ernest and Young , performed an external audit dating up to 31 December 2018 and determined both companies had sufficient financial resources to meet the costs of cyanide decommissioning activities.

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## 2.6 Principle 6 – Work Safety

### 2.6.1 Standard of Practice 6.1

**Identify potential cyanide exposure scenarios and take measures as necessary to eliminate, reduce and control them.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 6.1

not in compliance with

**Summarise the basis for this Finding/Deficiencies Identified:**

The operation is in FULL COMPLIANCE with the Standard of Practice 6.1 requiring the operation to identify potential cyanide exposure scenarios and take measures as necessary to eliminate, reduce, and control them.

The operation has developed procedures describing how cyanide-related tasks such as unloading, mixing, plant operations, entry into confined spaces, and equipment decontamination prior to maintenance should be conducted to minimise worker exposure.

- Unloading – unloading boxed cyanide is managed through the Unloading Cyanide Boxes from Sea Container Procedure and Delivering Cyanide to Reagent Shed Procedure.
- Mixing – mixing cyanide is managed through the Cyanide Mixing Storage & Distribution Procedure.
- Plant Operations – There are in excess of 50 Processing/Milling Area procedures that address cyanide related tasks.
- Maintenance procedures – There are a series of seven main maintenance procedures that address cyanide related maintenance tasks.
- Confined Space entry is addressed in the PJV OHS-SIT-STD-004 Confined Space Entry site standard.
- Decontamination – The Working with Equipment Associated with Cyanide and Cyanide Decontamination and Decommissioning procedure deal with decontamination of cyanide contaminated equipment prior to maintenance.

The procedures are developed using a common format using the following headings:

- Purpose.
- Frequency of the task.
- Skills required.
- Equipment required.
- Permits/tickets required.
- Hazardous materials.
- Cyanide safety.
- Environmental aspects and impacts.



- Hazards and controls.
- PPE required.
- Procedure method.
- Housekeeping.
- References.
- Assessment process.

The formalised training program ensures process and maintenance personnel are trained and assessed in these procedures. To supplement the procedures and training, there is signage to remind personnel of rules and PPE for cyanide related tasks.

The procedures require, where necessary, the use of personal protective equipment (PPE) and address pre-work inspections.

All procedures contain sections, which details the required equipment (e.g., HCN gas detector) and PPE (e.g. ear protection) required for the task. The minimum PPE standard for the site is steel-capped boots, hard hat, glasses, long sleeved collared shirt and long trousers and high-visibility vest.

Signage at the higher-risk areas also inform workers entering these areas what PPE is necessary.

Prior to commencing work at the Processing Plant, contractors and employees are required to complete a general induction and mill specific induction. During inductions, the appropriate PPE for the areas, and task specific PPE, is highlighted. A Cyanide Awareness Presentation is included within the induction for workers accessing cyanide areas. This presentation includes details on PPE for cyanide specific tasks.

Employees receive further training and assessment, using the procedures as the foundation of the training, prior to being considered competent and allowed to work on their own. These training packages identify what type of PPE is required for each area or task.

All employees and contractors working on the site are required to undertake an assessment prior to conducting tasks. The type of risk assessment undertaken is dependent on the task.

Pre-work inspections are conducted through a range of different mechanisms, including Job Hazard Analysis (JHAs) and FLRA. A FLRA is undertaken prior to conducting routine tasks. The process prompts workers to stop what they are doing, assess the risk and make any changes. A JHA or team-based risk assessment is conducted for non-routine or unfamiliar tasks, while a formal risk assessment is conducted for changes to processes or an introduction of new processes.

The operation does solicit and actively consider worker input in developing and evaluating health and safety procedures. The risk assessment process (6.1.2) and the change management process (6.1.3) are used to identify where new procedures or revision to procedures are required.

Procedures are reviewed by team members within each department that the procedure specifically relates to. The team supervisor is responsible for coordinating the review with relevant stakeholders. Once comments have been considered the procedure is approved and incorporated into PJV's document control system. All approved procedures are available to employees via the intranet and any employee can propose changes to a procedure even if it is not due to be reviewed. Each procedure has a specified review period.

Other mechanisms utilised to solicit and actively consider worker input into procedures include:

- Safety meetings.
- Toolbox meetings.

Pre-start meetings and daily shift meetings.



## 2.6.2 Standard of Practice 6.2

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

in full compliance with

The operation is  in substantial compliance with Standard of Practice 6.2

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 6.2 requiring the operation to operate and monitor cyanide facilities to protect worker health and safety and periodically evaluate the effectiveness of health and safety measures.

The operation has determined the appropriate pH for limiting the evolution of HCN gas during mixing and production activities. No change has occurred to the operation in relation to this audit protocol since the 2016 audit.

The Porgera metallurgists have determined that, based on its solution chemistry, a target pH of 10.5 shall be maintained throughout its operation to limit the evolution of HCN gas. The target pH will be communicated to the operators as part of the Leach Circuit Training program and by way of a set point board in the control room.

The slurry entering the Conditioning Tank will have a pH of 1.5 (which will be raised to 10.5 prior to the addition of cyanide). The pH is monitored using an automated probe in the Conditioning Tank and Leach Tank 0. When the pH in Leach Tank 0 drops below the pH set point the lime actuator valve will open to dose more lime into the Conditioning Tank.

An interlock exists between the pH probe and the cyanide dosing pump. If the pH of the Conditioning Tank or Leach Tank 0 drops below a pH of 9.5 the Cyanide Pump will stop. The process will only restart if the pH is above the set point of 10.5.

Advisory alarms inform the control room operator if pH is outside of set parameters. The process operators will record pH values in the Leach Circuit Logsheet every two hours when operations commence.

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

The site undertook a HCN meter reading survey in 2012 to determine whether there are elevated levels of HCN in areas where no fixed HCN monitors are installed. The results indicated that all levels are well below the compliance limit of 4.7 ppm for 8-hours exposure or 10 ppm for immediate removal from the area.

Employees are made aware of these areas and activities through induction, procedure training and signage. All procedures note the PPE requirements.

Where the potential exists for significant cyanide exposure, the operation uses static and personal monitoring devices to confirm that controls are adequate to limit worker exposure to HCN gas.

HCN gas levels are monitored by fixed detectors mounted in key locations. There are 20 fixed detectors installed in the Processing Plant.

Personal monitors are required to be worn when accessing a number of areas around site or undertaking various cyanide-related activities. The requirement to wear a personal monitor is specified within the procedures, which were developed using a risk assessment process.

Both the personal and fixed monitors are set to alarm at 4.7 ppm and 10 ppm. If HCN levels reach 4.7 ppm, the alarm is to alert personnel of HCN gas presence. Work may continue with an increased frequency of HCN monitoring. If workers are required to be in the area for a prolonged period, breaks are required to avoid exceeding exposure limits.

If HCN levels reach 10 ppm, a siren and flashing light is activated, and the area must be evacuated immediately by the safest route and secured to prevent re-entry. The area cannot be re-entered unless levels drop below 4.7 ppm.

The fixed HCN detectors and the personal gas detection monitors are maintained, tested and calibrated as per the manufacturer directions. The records relating to the fixed detectors are maintained by the Instrumentation Team. The



operation has provisions to keep calibration records for hydrogen cyanide gas monitors for at least three years, as per the Code.

Inspection, testing and calibration of fixed and personal HCN monitors is done monthly. Personal units out of calibration are automatically disabled. Calibration records for monitors on-site were viewed.

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

Signage is provided in English and in Tok Pisin, a language used to facilitate communication amongst English speakers and those who speak the vernacular languages of PNG.

Access is restricted to the treatment plant area, with no one permitted to enter the processing area until they have completed the induction, area specific induction and cyanide hazard awareness training and assessment. These training packages stipulate no smoking, eating or drinking in the Processing Plant area. All treatment plant personnel and maintenance workers in this area receive this training.

There are signs and gates when entering the Processing Plant area noting cyanide is present, and that smoking, open flames and eating and drinking are not allowed.

High strength cyanide will be dyed for clear identification. Mixing of cyanide occurs in the Mixing Tank. Carmoisine dye will be added to the mix to give the prepared cyanide solution a distinct red colour.

Showers, low-pressure eyewash stations and dry-powder fire extinguishers were located at strategic locations throughout the operation in the cyanide areas, and are maintained, inspected and tested on a regular basis.

The planned inspection checklists are completed by the operators on a weekly rotational schedule and the checklist prompts the inspections of safety showers, the low-pressure eyewash stations and fire extinguishers. Any issues identified are actioned through the work order system.

A check of the showers and eyewash stations noted that the pressure was appropriate. Inspection and tagging of the fire extinguishers are undertaken on-site by Emergency Response Team (ERT) .

Unloading, storage, mixing and process tanks and piping containing cyanide are identified to alert workers of their contents, and the direction of cyanide flow in pipes is designated.

Tanks and piping containing high and medium strength cyanide are adequately labelled. The tanks are painted with a lilac band and accompanying signage. The pipe was either painted lilac and/or had a lilac stick-on label with arrows indicating the direction of flow.

Low strength cyanide pipes are addressed through a number of signs located in the process area that state “Warning – treat all vessels, tanks, slurry and solution lines inside area as if containing cyanide”.

MSDS, first aid procedures or other informational materials on cyanide safety in the language of the workforce is available in areas where cyanide is managed. MSDSs and first aid instructions are posted at all designated cyanide areas. An electronic MSDS database, Chemwatch, is available via the intranet. In addition, the cyanide awareness training is presented to all personnel at induction.

The company has a minimum requirement of all personnel working in the cyanide plant to have a level of education that will allow them to read English therefore documents are mainly in English.

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

In the event of a cyanide release and or exposure incident, the Safety and Health Incident Reporting and Investigation Standard is in place to investigate and evaluate cyanide incidents to identify root causes and implement corrective actions. This procedure is tied into INX (integrated Health, Safety, and Environment management system) and guides personnel through the investigation process and ensures that adequate levels of review and approvals take place. The level of investigation required is scaled based on the seriousness (and serious potential) of the incident. Incident investigations involve the relevant departments.

A review of the effectiveness and adequacy of the cyanide procedures plans and or work instructions relevant to the incident is conducted as part of the incident investigation. The documents are updated if the review highlights that revision to either administrative or process controls and or task methodology is required. No cyanide exposure related incidents have occurred.



### 2.6.3 Standard of Practice 6.3

#### Develop and implement emergency response plans and procedures to respond to worker exposure to cyanide.

in full compliance with

The operation is  in substantial compliance with Standard of Practice 6.3

not in compliance with

#### Summarise the basis for this Finding/Deficiencies Identified:

PJV is in FULL COMPLIANCE with Standard of Practice 6.3 requiring the operation to develop and implement emergency response plans and procedures to respond to worker exposure to cyanide.

The operation has the necessary equipment to respond in the event of a worker's exposure to cyanide.

An adequate water supply was observed for rinsing and cyanide decontamination at numerous showers and eyewash stations located strategically around the site.

An adequate supply of oxygen was observed in the safety boxes strategically placed around the Processing Plant, in the Medical Centre and ambulances. The ERT also have dedicated equipment that they maintain. The oxygen was present in the form of Oxyvivas, oxyports and medical cylinders. All systems have "on demand" valved mouth pieces replacing the need for separate resuscitators.

The operation has an onsite Medical Centre staffed by medical officers (doctors), and nurses. Cyanide antidote kits are stored at the Medical Centre.

There is a radio system (Channel 1) and telephone (4222) which can be used to raise the alarm in an emergency. The emergency notification procedure is detailed in the induction training.

Radios, telephones and a public announcement system are available throughout the Processing Plant, which can be used to raise the alarm in an emergency.

The operation inspects its first aid equipment regularly to ensure that it is available when needed. The mill area safety equipment and emergency cabinets are inspected by both Operations (on a weekly and a fortnightly basis) and ERT personnel.

The operation follows the manufacturer's instructions for storing the cyanide antidote kits.

The operation has developed specific written emergency response plans or procedures to respond to cyanide exposures. The operation has developed and implemented a site-specific Cyanide Emergency Response Plan (CERP) and cyanide treatment protocol to respond to cyanide exposures.

The CERP notes that cyanide exposure scenarios represent a real risk to the operation and as such the plan has developed a pre-incident plan for a cyanide related injury. These procedures are enforced through cyanide awareness training, procedures, and signage out in the treatment plant at strategic positions where there are high-risk, cyanide tasks.

Section 5 of the CERP provides guidelines for first response and treatment in the form of decontamination, oxygen and antidotes for personnel suspected of suffering the effects of cyanide poisoning. An adequate supply of cyanide antidote is maintained at the on-site Medical Centre.

The procedure for Preventing and Responding to Cyanide Poisoning provides detailed instructions for responding to cyanide exposures. The Cyanide Protocol contains detailed instructions on the cyanide antidote use, which is only administered under the direction of a registered medical practitioner. The operation does have its own on-site capability to provide first aid or medical assistance to workers exposed to cyanide.

The operation has an on-site Medical Centre that is staffed by medical officers and nurses. The facility is open 24 hours and a medical officer is on call during the night shift. The Medical Centre maintains Cyanokits (cyanide antidote kits).

The Medical Centre is fully equipped with a two-bed ward, mini theatre, four clinic treatment areas and an emergency room. There are two ambulance vehicles and one administrative car based at the medical centre.



First Aid and cyanide exposure scenarios are included as a requirement of ERT training. The ERT are the primary response team for cyanide emergencies, however all process staff are instructed on the actions to take in the event of a cyanide exposure.

The medical staff are aware of the procedure to administer cyanide antidotes in the event of cyanide exposure. Training records were viewed for clinic personnel in the Cyanokit Awareness Training.

The operation has developed procedures to transport workers exposed to cyanide to locally available qualified off-site medical facilities.

The operation is confident that the onsite medical facility has adequate, qualified staff, equipment and expertise to respond to cyanide exposures. If required patients can be evacuated to the Mount Hagen Hospital. The Secondary Evacuation Response Plan describes the measures and action to be taken to transport workers to offsite medical facilities.

The operation has made formalised arrangements with local hospitals, clinics, etc, so that these providers are aware of the potential need to treat patients for cyanide exposure.

The operation is confident that the onsite medical facility has adequate, qualified staff, equipment and expertise to respond to cyanide exposures. If required patients can be evacuated to the Mount Hagen Hospital. The Secondary Evacuation Response Plan describes the measures and action to be taken to transport workers to offsite medical facilities.

Formalised agreements in the form of Memorandum of Understanding (MOU) exist between PJV and the Mount Hagen Hospital in relation to treating patients. In the event of a significant cyanide related injury, it is likely that the injured personnel will be airlifted to Cairns Base Hospital via Hevilift owned and operated fixed wing or helicopter aircraft.



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## 2.7 Principle 7 – Emergency Response

### 2.7.1 Standard of Practice 7.1

#### Prepare detailed emergency response plans for potential cyanide releases.

in full compliance with

The operation is  in substantial compliance with Standard of Practice 7.1

not in compliance with

#### Summarise the basis for this Finding/Deficiencies Identified:

PJV is in FULL COMPLIANCE with Standard of Practice 7.1 requiring an operation prepare detailed emergency response plans for potential cyanide releases.

The Operation has developed plans which all have a role in emergency response and address potential accidental releases of cyanide. The plans outline the equipment, personnel and other resources allocated to the PJV emergency response.

The plans include:

- Hazardous Materials (HAZMAT) Emergency Response Plan
- CERP
- Barrick Porgera Emergency Medical Technician Plan

These plans are supported by the following SOPs:

- Preventing and Responding to Cyanide Awareness
- Cyanokit Protocol
- Medical Secondary Evacuation Response Plan

The operation's emergency documentation does consider the potential cyanide failure scenarios appropriate for its site-specific environmental and operating circumstances.

The operation has identified the scenarios that present the highest risk of a spill or release of cyanide or cyanide bearing material occurring at PJV. These scenarios are:

- An accident during transport resulting in shipping container damage or fire.
- A catastrophic release from a high strength cyanide solution tank or pipeline
- A large quantity spill during unloading of sea containers and or transport of cyanide boxes to the reagent mixing shed.
- Large process slurry spills and or leaks outside of secondary containments.
- Personnel exposed to hydrogen cyanide.
- A fire event with cyanide or cyanide contaminated equipment involved.

It is considered that these cover the potential cyanide failure scenarios appropriate for its site specific environmental and operating circumstances relevant to site operations.

The emergency documentation considers both on-site transportation emergencies and the physical form of cyanide. The site will receive cyanide in solid form in intermediate bulk containers (IBCs) from Orica.

Off-site Transport emergencies will be managed under the Code certified transporter, Mapai Transport, through their Cyanide Transport Emergency Management Plan (CTEMP) which has been developed jointly with PJV. However, the



CERP addresses release scenarios resulting from transport accidents onsite, where cyanide is spilt either within or outside the sea containers.

The emergency documentation details response actions (as appropriate for the anticipated emergency situations) such as clearing site personnel from the area of exposure, use of cyanide antidotes and first aid measures.

The CERP provides response actions for the first onsite, including evacuation, alerting ERT and incident management. The Cyanokit Protocol address the administration of the cyanide antidote, Cyanokit and first aid measures.

Emergency response procedures describe measures to control cyanide releases at their source and address the containment, assessment, mitigation and prevention of future releases.

PJV has determined that there are no potentially affected communities in close proximity to the operation. The workforce at PJV is considered to be the main group at risk from an on-site cyanide emergency, as an anticipated incident will not involve potentially affected downstream or nearby communities.



## 2.7.2 Standard of Practice 7.2

### Involve site personnel and stakeholders in the planning process.

in full compliance with

The operation is  in substantial compliance with Standard of Practice 7.2

not in compliance with

### Summarise the basis for this Finding/Deficiencies Identified:

PJV is in FULL COMPLIANCE with Standard of Practice 7.2 requiring an operation to Involve site personnel and stakeholders in the planning process.

The operation has involved its workforce in the cyanide emergency response planning process. This was undertaken during the initial development of the plan which has not had material changes since its inception

The operation has in place mechanisms to consult with its workforce who are the main stakeholders for cyanide related emergencies. The external community has not been involved in the emergency response planning, PJV has determined that there are no potentially affected communities in close proximity to the operation.

PJV has determined that there are no potentially affected communities in close proximity to the operation. The workforce is considered to be the main group at risk from an on-site cyanide emergency, as an anticipated incident will not involve potentially affected downstream or nearby communities.

The operation has developed and implemented a cyanide awareness training session as part of the site induction program which is compulsory for all persons on the operation's site. The training covers the nature of the risks associated with accidental cyanide releases and what action to take in the event of an emergency.

PJV is a remote site that is largely self-reliant in the event of an emergency. Despite this, the operation has developed procedures to transport workers exposed to cyanide to qualified, off-site, medical facilities. Workers exposed to cyanide will be treated in the first instance by on-site medical practitioners and then transferred to Mount Hagan Hospital as necessary. MOUs exist between PJV and the Mount Hagan Hospital.

The operation does engage in consultation or communication with stakeholders to keep the Emergency Response planning current. The main stakeholder for the operation is its workforce and the operation engages through mock exercises and through safety meetings where revisions to procedures and plans are discussed and implemented. The emergency response documentation has recently been reviewed.



### 2.7.3 Standard of Practice 7.3

**Designate appropriate personnel and commit necessary equipment and resources for emergency response.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 7.3

not in compliance with

**Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 7.3 requiring an operation designate appropriate personnel and commit necessary equipment and resources for emergency response.

The PJV emergency documentation does clearly address the required cyanide related elements.

- a. The emergency documentation clearly identifies the Incident Management Team and the responsibilities of each role.
- b. The operation has an on-site ERT comprised of full-time personnel. The operation's emergency response plans and procedures identify the ERT members.
- c. The CERP describes the training requirements for PJV ERT Personnel. Processing plant personnel, training requirements are described in the CMP.
- d. All emergency calls are received by the site Security Control Centre (SCC). This office is manned 24 hours a day. SCC will then activate the relevant pager systems for responders based on the incident location, nature and severity. The CERP contains key contact numbers.
- e. The emergency documentation clearly identifies the Incident Management Team and the responsibilities of each role. Section 3.
- f. The CERP and the HAZMAT Emergency Response Plan outline the equipment, personnel and other resources allocated to the PJV emergency response.

The operation has procedures to inspect the emergency response equipment to ensure its availability.

The roles of outside responders and medical facilities have been detailed in the emergency documentation where relevant. Excluding medical services and the involvement of the supplier in an emergency, PJV does not anticipate the involvement of external parties.

The operation has confirmed that outside entities included in the CERP are aware of their involvement and are included as necessary in mock drills or implementation exercises.

PJV is a remote site that is largely self-reliant in the event of an emergency. Despite this, the operation has developed procedures to transport workers exposed to cyanide to qualified, off-site, medical facilities. Workers exposed to cyanide will be treated in the first instance by on-site medical practitioners and then transferred to Mount Hagan Hospital as necessary. MOUs exist between PJV and the Mount Hagan Hospital.

The CERP states that external parties, where possible, will be included in mock drills. Give the location of the operation and the travel time to medical assistance, cyanide exposure incidents would be decontaminated and treated on site and then the patient would be sent for ongoing medical care if needed.



## 2.7.4 Standard of Practice 7.4

**Designate appropriate personnel and commit necessary equipment and resources for emergency response.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 7.4

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 7.4 requiring the development of procedures for internal and external emergency notification and reporting.

The emergency documentation does include procedures and contact information for notifying management, ERT, medical officers and cyanide suppliers.

All emergency calls are received by the site SCC. This office is manned 24 hours a day. SCC will then activate the relevant pager systems for responders based on the incident location, nature and severity. The CERP also contains a list of specialist contact numbers and key personnel as well as the current supplier, Orica.

The CMP details the process for contacting regulatory agencies. The Superintendent Emergency Response advised that the CMP states "In the event of serious injury or fatality as a result from cyanide exposure PJV would complete form 14 which is a Mineral Resources Authority (MRA) requirement for incidents/accidents. Executive General Manager (EGM) or delegate would review then send to MRA via email."

Emergency management documentation contains procedures and contact information for notifying potentially affected communities of the cyanide related incident and any necessary response measures, including communication with the media in the event of a cyanide emergency.

The PJV workforce is considered to be the main group at risk from an onsite cyanide emergency as an anticipated incident would not involve potentially downstream or nearby communities.

The operation does have a written procedure for notifying ICMI of any significant cyanide incidents, as defined in ICMI's Definitions and Acronyms document. The procedure has been documented in the Cyanide Management Plan. According to Facility personnel there has been no significant cyanide incidents that have occurred that had to be reported to the ICMI.



## 2.7.5 Standard of Practice 7.5

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

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 7.5

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 7.5, requiring an operation develop procedures for internal and external emergency notification and reporting.

The emergency documentation does address all the required items. The CERP covers:

- Use of ferrous sulphate monohydrate for use in neutralisation of soils, including testing after treatment to confirm neutralisation. The CERP includes the location of ferrous sulphate bags (Emergency Response), the guideline for the quantities to utilise on dry/liquid cyanide and the procedure to use ferrous sulphate on a spill.
- Decontamination of equipment through the use of hydrogen peroxide, ensuring it is completed within a bunded area to ensure washing water is channelled to the Destruction Plant. The CERP specifies the concentrations of hydrogen peroxide and ratio with water to use for decontamination, the decontamination process and the location hydrogen peroxide is stored (Warehouse).
- Disposal of contaminated soils and wastes from neutralisation and decontamination process. Contaminated soil will be taken to the crusher for safe disposal. The remediation procedures include the maximum acceptable level of residual cyanide in soil for disposal.
- Decontamination of Waterways, including the prohibition of sodium hypochlorite, ferrous sulfate and hydrogen peroxide in treatment.

*The CERP states that it is extremely unlikely that levels of cyanide dangerous to people could impact either Kogai Creek or the Pongema River from an uncontrolled release occurring in the mill area. At present, local residents do not drink from this water source due to the turbidity of the water, and instead obtain drinking water from its tributaries and installed rainwater tanks. The mine itself does not source its drinking water from this area. It is highly unlikely that the operation could adversely impact any groundwater drinking sources from a release due to primary and secondary containment of all cyanide, leak detection processes, groundwater monitoring and a robust emergency response process.*

The CERP covers decontamination of waterways, including the prohibition of sodium hypochlorite, ferrous sulfate and hydrogen peroxide in treatment.

The CERP allocates the responsibility to the Environmental Manager for ensuring the Environment Department personnel are competent in developing post-cyanide emergency monitoring plans and are competent in the use of cyanide monitoring equipment. The Environment Department has a number of procedures on environmental monitoring.



## 2.7.6 Standard of Practice 7.6

**Periodically evaluate response procedures and capabilities and revise them as needed.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 7.6

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 7.6, requiring an operation periodically evaluate response procedures and capabilities and revise them as needed.

The operation does review and evaluate the cyanide related elements of its emergency response plan for adequacy on a regular basis.

The emergency documentation includes requirements to be reviewed and revised (if required) following all cyanide related emergencies and exercises (in the absence of incidents, review and revision should occur after a cyanide emergency exercise) actions arising from review should be tracked to completion and revision information kept on file.

The CERP requires the completion of mock drills it states that:

*PJV will conduct one cyanide specific emergency response drill per year and involve all onsite stakeholders.*

*Where possible, PJV will attempt to involve external service providers in emergency response drills to ensure providers are available and reliable, and to ensure site personnel are trained in the entire cyanide emergency response processes.*

Evidence was provided that a recent emergency drill were held. The response to an employee that was overcome by cyanide poisoning inside a process tank was simulated. The facility intends to conduct mock drills that will involve cyanide exposure and release scenarios when operations commence.

The CERP is required to be reviewed and updated after a cyanide emergency.

The recent Cyanide Emergency Drill Debrief Report shows that provision were in place to evaluate emergency response plans. The report's recommendations include review and update emergency response training procedures and protocols for HAZMAT response in accordance with the outcome of the debrief report.



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## 2.8 Principle 8 – Training

### 2.8.1 Standard of Practice 8.1

**Train workers to understand the hazards associated with cyanide use.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 8.1

not in compliance with

**Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 8.1 requiring that an operation trains its workers to understand the hazards associated with cyanide use.

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

All personnel working on the Processing Plant are required to complete Cyanide Safety Awareness training as part of their onboarding and inductions. This training consists of both theory and practical components and each section must be successfully completed to be deemed competent.

The operation's cyanide awareness training thoroughly covers cyanide hazards, the health effects of cyanide, symptoms of cyanide exposure, and the procedures to follow in case of exposure.

A sample of training records reviewed identified that Cyanide Awareness is provided to personnel working on the Processing Plant and that refresher training is completed annually. Cyanide training records are retained.

PJV use Employee Training Assessment Management System (ETAMS)/Oracle to manage the competencies, compliances and procedures/work instructions that each role requires for a person to undertake their job safely and effectively.

PJV also retain hard copies of completed training attendance and assessments.



## 2.8.2 Standard of Practice 8.2

**Train appropriate personnel to operate the facility according to systems and procedures that protect human health, the community and the environment.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 8.2

not in compliance with

### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 8.2 requiring that an operation trains appropriate personnel to operate the facility according to systems and procedures that protect human health, the community and the environment.

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

PJV use a range of administrative and procedural methods to define the risks associated with individual cyanide tasks, minimise hazards arising from cyanide storage, handling and use in operations and ensure worker safety when completing their regular tasks. These include:

- Inductions
- Training manuals
- SOPs
- Task Based Observations (TBOs)
- JHA
- FLRA
- MoC procedures.

Training is based on a Competency Based Assessment Process (CBA) that includes a mentoring or buddy system and before employees are allowed to perform a task solo they are put through the following steps:

- Instructed and shown how to do the task.
- Read the operating procedure.
- Observed and coached whilst performing the task.
- Successfully pass a competency-based test on the task.
- Undertake the task solo.

TBOs are used to verify an employees' competency before they are signed off and permitted to work in a given area and or undertake a particular task unsupervised.

Through the development of the ETAMS, training elements and competencies related to specific training elements are identified.

Critical training, such as cyanide awareness, is completed prior to the employee being approved for work tasks.

Training is undertaken by qualified personnel.

The training program and CBAs are completed by nationally certified trainers (NC213). Field trainers that complete the TBO are specifically knowledgeable to each plant area and will mentor new starters in this area.

The operation does train all personnel prior to working with cyanide

All personnel working on the Processing Plant are required to complete Cyanide Safety Awareness training as part of their onboarding and inductions. Cyanide Safety Awareness refresher training is required on an annual basis.

Personnel training is indicated on their competency card which employees have to keep with them at all times. Competency cards are checked before employees can start work.



Cyanide Safety Awareness refresher training is required on an annual basis. The ETAMS clarifies training requirements for each employee and refresher training and directs Supervisors when training is nearing its expiry. The operation also provides refresher training specific to cyanide related work tasks.

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

All training is competency based and includes a theoretical and practical assessment.

Both hard copy and electronic records are maintained for each employee. Electronic records are stored in ETAMS and hard copies on each person's file in the Process Training Office and ERT Supervisors office.

The auditor observed training files in both hard and electronic copy for a sample of processing, maintenance and emergency personnel.

Records include the names of the employee and the trainer, the date of training, the topics covered, and if the employee demonstrated an understanding of the training material.



### 2.8.3 Standard of Practice 8.3

**Train appropriate workers and personnel to respond to worker exposures and environmental releases of cyanide.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 8.3

not in compliance with

#### **Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 8.3 requiring an operation train appropriate workers and personnel to respond to worker exposures and environmental releases of cyanide.

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

The operation has developed SOPs for response to cyanide spills and as well as emergency documentation. All personnel working in the processing area complete the cyanide awareness training, followed by further area specific training, which includes information on actions to take if cyanide is released in their work area.

All personnel receive instruction and training on emergency response and raising the alarm. The primary response actions for processing and maintenance personnel are to raise the alarm and evacuate the area.

The ERT are responsible for emergency response, along with the support of experienced personnel in the area of the emergency. The ERT members have completed HAZMAT training in accordance with Australian Training Qualifications Framework.

Site cyanide response personnel, including unloading, mixing, production and maintenance workers, are trained in basic decontamination and first aid procedures and take part in routine drills to test and improve their response skills.

The ERT receive more advanced training in decontamination and first aid and generally facilitate the drills to test and improve skills. The ERT train daily and this training includes response to chemical incidents.

The CERP requires the completion of mock drills it states that:

*PJV will conduct one cyanide specific emergency response drill per year and involve all onsite stakeholders.*

*Where possible, PJV will attempt to involve external service providers in emergency response drills to ensure providers are available and reliable, and to ensure site personnel are trained in the entire cyanide emergency response processes.*

Evidence was provided identified that drills were held yearly and included Processing and ERT personnel.

Site cyanide response personnel, including unloading, mixing, production and maintenance workers, are trained in the use of response equipment and related procedures and take part in routine drills to test and improve their response skills.

The ERT receive more advanced training in decontamination and first aid and generally facilitate the drills to test and improve skills. The ERT train daily and this training includes response to chemical incidents.

Full time ERT members must complete the national *Australian certification PUA FIR320 – Render Hazardous Materials Incidents Safe*. Following this certification each full time officer must participate in at least one mock Drill or skills maintenance session, per year. All Volunteer ERT members must maintain their competency through regular skills and maintenance training and be deemed competent and meet the requirements of the Standard Task Assessment (STA) for ERT volunteers. The requirements of this site qualification must be met annually.

PJV is a remote site that is largely self-reliant in the event of an emergency. However, formalised agreements/arrangements have been made with the relevant regional hospital.

Workers exposed to cyanide will be treated in the first instance by on-site medical practitioners and then transferred to Mount Hagan Hospital as necessary. MOUs exist between PJV and the Mount Hagan Hospital.



All employees and contractors that work at the PJV site undertake Cyanide Awareness training at the commencement of their employment/contract and then annually (as a refresher course). This training is coordinated by the Process Safety Department and includes details with respect to Emergency Response.

Records are retained documenting the cyanide training, including the names of the employee and the trainer, the date of training, the topics covered, and how the employee demonstrated an understanding of the training materials. Training records are updated in ETAMS. Various training records were sighted during the audit.



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## 2.9 Principle 9 – Dialogue and Disclosure

### 2.9.1 Standard of Practice 9.1

**Promote dialogue with stakeholders regarding cyanide management and responsibly address identified concerns.**

**in full compliance with**

The operation is  in substantial compliance with Standard of Practice 9.1

not in compliance with

**Summarise the basis for this Finding/Deficiencies Identified:**

PJV is in FULL COMPLIANCE with Standard of Practice 9.1 requiring the operation to provide stakeholders the opportunity to communicate issues of concern.

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

The operation has a Grievance Procedures, which allows members of the local community to liaise with the operation about concerns.

The Grievance Procedure and other stakeholder information is advertised through a variety of means amongst local stakeholders, including:

- Notice boards/billboards
- Radio communication (in multiple languages) – Operations only
- Newsletters (internal only during care and maintenance and external distribution during operations)

The mine site supports the local provincial radio station. The newsletter, Porgera Positive, is distributed to both internal and external stakeholders on a monthly basis.

The site employs Community Relations Officers (CROs) who liaise with the communities nearby the mine site, along the river downstream of the mine and along the highway which provides access to the site. The CROs have ongoing and regular discussions of an informal nature with community members about all aspects of the mine operation and provide any feedback to the operation. The officers liaise with populations along the highway route to discuss the meaning of the signage, maintaining distance from containers, and to provide contact details of CROs and Security.

The CROs are able to converse in five separate languages used in the area: English, Pidgin, Engan, Tari and Ipili. All CROs also complete the mill induction and Cyanide Awareness training so that they gain a greater awareness of the use of cyanide on site and can communicate information about this.

There is also a Grievance Office at Yoko, which is publicly accessible for stakeholders.

The site invites members of the local community to visit the site and provides a tour for these visitors. Visitors have included councillors (village leaders), teachers and students.

External stakeholders include government, NGOs, Mineral Resource Authority, University groups and Porgera District Women's Association. Information on cyanide use is presented at these meetings.

Internally, site inductions, which includes information on cyanide, are required for all employees, contractors and visitors prior to working on the site. Questions are encouraged during the site induction.



## 2.9.2 Standard of Practice 9.2

### Make appropriate operational and environmental information regarding cyanide available to stakeholders.

in full compliance with

The operation is  in substantial compliance with Standard of Practice 9.2

not in compliance with

#### Summarise the basis for this Finding/Deficiencies Identified:

PJV is in FULL COMPLIANCE with Standard of Practice 9.2 requiring the operation to make appropriate operational and environmental information regarding cyanide available to stakeholders.

The operation has developed written descriptions of how their activities are conducted and how cyanide is managed, and these descriptions are available to communities and other stakeholders.

Porgera has made the descriptions available via internal and external mechanisms. In addition all internal departments have “read only” access to written procedures.

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

Written information, such as contained in site induction, Cyanide Awareness training and monthly safety topic are also discussed in internal and external working groups and meetings.

Community consultation is completed verbally in the language of the community. The CROs are able to converse in four separate languages used in the area: English, Pidgin, Engan and Ipili.

No releases that are or that cause applicable limits for cyanide to be exceeded have occurred since the start of mine operation in 1990. No cyanide exposure incidents resulting in hospitalisation or fatality occurred since the last ICMC recertification audit.

PJV is required to submit an Annual Environmental Report (AER) to government regulators, namely the PNG CEPA. The AER details environmental incidents that occurred onsite during the reporting period. Cyanide monitoring details and cyanide releases are reported in the AER and the AER is publicly available.

As the local communities surrounding Porgera operations typically do not have access to the internet or television and often have little or no comprehension of written or verbal English, accurate communication of an incident can often be difficult in Tok Ples or Tok Pisin.

It is acknowledged that there is often a real risk of overreaction by local communities which can lead to increased safety and environmental risk from retaliation. Consequently, the communications strategy following an incident would depend on the circumstances surrounding each individual incident. At a minimum, Porgera would:

- Adhere to all regulatory and corporate reporting requirements
- Communicate and consult directly with any community regarding a cyanide incident where not to do so would increase the risk to that community
- Not deliberately mislead the community as to consequences resulting from an incident involving cyanide
- Report all incidents through established internal reporting protocols.

PJV will communicate any incidents of cyanide exposure resulting in hospitalization or fatality through a variety of channels, including the Porgera newsletter, the annual environmental report, and regular community awareness campaigns conducted by CSR.



### 3 Limitations

Your attention is drawn to the document titled – “Limitation Statement”, which is included in Appendix A of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Limitation Statement document does not alter the obligations WSP has under the contract between it and its client.



# Appendix A

## Limitations





# Limitation Statement

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