Cyanide Production Operation

Summary Audit Report

for

The International Cyanide Management Institute

and

Proguigel Candeias Unit/ 2023

Prepared by NCABrasil Expert Auditors Ltd.

(www.globalsheq.com)

This report contains 19 (nineteen) pages.

Proquigel Candeias Name of Producer	Signature of Lead Auditor	21/01/2024 Date

SUMMARY AUDIT REPORT
FOR CYANIDE PRODUCTION OPERATIONS

Instructions

2

1. The basis for the finding and/or statement of deficiencies for each Standard of Practice should be summarized in this Summary Audit Report. This should be done in a few sentences or a paragraph.

2. The name of the mine operation, lead auditor signature and date of the audit must be inserted on the bottom of each page of this Summary Audit Report. The lead auditor's signature at the bottom of the attestation on page 3 must be certified by notarization or equivalent.

3. An operation that is in substantial compliance must submit a Corrective Action Plan with the Summary Audit Report.

4. The Summary Audit Report and Corrective Action Plan, if appropriate, with all required signatures must be submitted in hard copy to:

ICMI
1400 I Street, NW, Suite 550.
Washington, DC, 20005, USA.
Tel: +1-202-495-4020.

5. The submittal must be accompanied with 1) a letter from the owner or authorized representative which grants the ICMI permission to post the Summary Audit Report on the Code Website, and 2) a completed Auditor Credentials Form. The letter and lead auditor's signature on the Auditor Credentials Form must be certified by notarization or equivalent.

6. Action will not be taken on certification based on the Summary Audit Report until the application form for a Code signatory and the required fees are received by ICMI from the applicable gold mining company.

7. The description of the operations should include sufficient information to describe the scope and complexity of the gold mining operation and gold recovery process.

SUMMARY AUDIT REPORT

Name of Producer: Unigel – Candeias unit.
Name of Producer Owner: Proquigel Química S.A
Name of Producer Operator: Proquigel Química S.A.
Name of Responsible Manager: Jeovan Cardoso de Oliveira
Address: Fazenda Caioba s/n, Candeias, Bahia State.
Country: Brasil
Telephone: (5571) 986-741-343
Fax: not applicable
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Location detail and description of operation:

Proquigel Candeias Unit has its plant within the petrochemical complex in Candeias, a city located in Bahia state, in northeastern Brazil. It is 50 kilometers from São Salvador, the capital city of the state of Bahia and 30 kilometers from Camaçari Industrial Complex (where Proquigel/ Unigel group has another production plant of cyanide solution) which was the first planned petrochemical complex in Brazil. The access to the operation is through an asphalted road.

U 233 – CYANIDE REACTION

- The sodium cyanide manufacturing process is divided into the following phases:

a) **Dilution of sodium hydroxide:**

- This phase has the objective of diluting NaOH at a concentration of 50% through the use of demineralized water, so it can reach a concentration between 33% and 45% for NaOH. After dilution, the soda concentration will see to the needs demanded by the process for the NaCN concentration required.
- For a sodium cyanide concentration around 42%, they have to operate with caustic soda at a concentration of approximately 45%.
- The water coming from tank TQ 610.02/05 and the soda coming from tank TQ-920-15 are supplied by means of a pipeline and they are mixed in line. Considering the heat release caused by the dilution NaOH + H_2O (exothermic reaction), the mixture temperature rises about 10ºC and because of that it goes through a static mixer and is then fed to the diluted soda tank. (TQ-233-01).
- The diluted soda is stored and then sent to the phase where the reaction with hydrocyanic acid will take place.

b) **Reaction of hydrocyanic acid with soda**:

- Chemical Reaction

  The manufacturing of sodium cyanide is carried out through the direct reaction between liquid hydrocyanic acid and sodium hydroxide in aqueous solution. The reaction is as follows:

  $HCN + NaOH \rightarrow NaCN + H_2O$

- This is an exothermic reaction and it releases: 7.45 Kcal/mol of HCN or 152 Kcal/kg of NaCN.

  The temperature increase accelerates a secondary reaction for the formation of sodium formate and ammonia. The temperature during the synthesis should not exceed 55ºC, so that the formation of these impurities is not accelerated.

  $HCN + NaOH + H_2O \rightarrow HCOONa + NH_3$

- Due to the presence of SO2 as a stabilizer of the hydrocyanic acid we will also have the following reaction:
- $SO_2 + 2NaOH = Na_2SO_3 + H_2O$

  $SO_2 + 2\ NaOH \rightarrow Na_2\ SO_3 + H_2O$

c) Process description:

- Hydrocyanic acid (HCN) is fed to a mixer (venture type) within the reactor circulation circuit where the sodium cyanide solution goes to, containing an excess of soda in the order of 0,5 to 1,5% p/p. Inside the reactor circulation is maintained and it is responsible for the perfect homogenization of the solution.
- Given the heat that is released during the reaction, the circulation in the reactor goes through a heat exchanger (P-233-01) which is in charge of controlling the temperature so it will not surpass 45°C in the solution.
- The soda solution is introduced through the top of the reactor. It goes through an absorption column where the possible hydrocyanic acid vapors released in the solution are retained. Inert gases that go through the column are sent to the chimney by means of the nitrogen purge.
- Nitrogen is continuously introduced with the objective of dragging on possible vapors of hydrocyanic acid to the absorption column and also for maintaining the environment in an inert condition. The sodium cyanide solution extraction is continuously carried out to storage or control tanks and then transferred to the crystallization unit.

Gas washing column at the outlet:

- There is a packed gas washing column T-233-01 at the reactor vent space. The soda is fed to the reactor through the upper part. Gases coming out of the reactor reach the T-233-01 base, when they are back washed in the soda in the first packing layer. After this, they pass through the second layer (demister) and are sent to the exhaustion system/chimney.

U 230 – SOLID CYANIDE

The saturated solution is continuously fed to an evaporator from which, in a super saturation condition, it goes on to a crystallizer. The evaporated water containing cyanide is condensed and then sent to the internal treatment of effluents.

The evaporator levels, as well as the crystallizer levels, are interdependent due to the column formed because of the vacuum in the system. The density factor (larger amount of fines or not) also affects those levels. The crystallizer is equipped with a low rotation (2 rpm) scraper agitator that maintains crystals in suspension, therefore avoiding decantation in its bottom. This is necessary because the suction of the crystal withdrawal pump in crystallizer B 230.06 A/B is not in the bottom of the equipment, but in the middle of the liquid.

After the evaporation of the water the solution will become super saturated and it will then “discharge” the crystals that were formed. Crystals formed in the evaporator are then enough to complete the level in the crystallizer and they are then sent to decantation tank TQ 230.10 by means of pump 230.06 A/B.

The crystal concentration control in the crystallizer is carried out by means of sampling done in this transfer current to TQ 230.10 and it is maintained within a range of 25 to 35%. The crystallizer level superficial solution, in which the thin crystals are supposed to be in suspension, continuously overflows to TQ 230.07 which at its turn transfers the solution to TQ 230.05.

- Reaction of the atmospheric air CO_2 with NaCN and NaOH:

$$2NaCN + CO_2 + H_2O \Rightarrow Na_2CO_3 + 2HCN$$

$$2NaOH + CO_2 \Rightarrow Na_2CO_3 + H_2O$$

These reactions are undesirable, since they can jeopardize the purity of the final product.

- Sodium formate formation:

$$NaCN + 2H_2O \Rightarrow HCOONa + NH_3$$

This reaction takes place at temperatures above 50^0C, but it occurs in a very slow way. This reaction is undesirable as well, since it also jeopardizes the purity of the final product.

Proquigel Candeias — Name of Producer

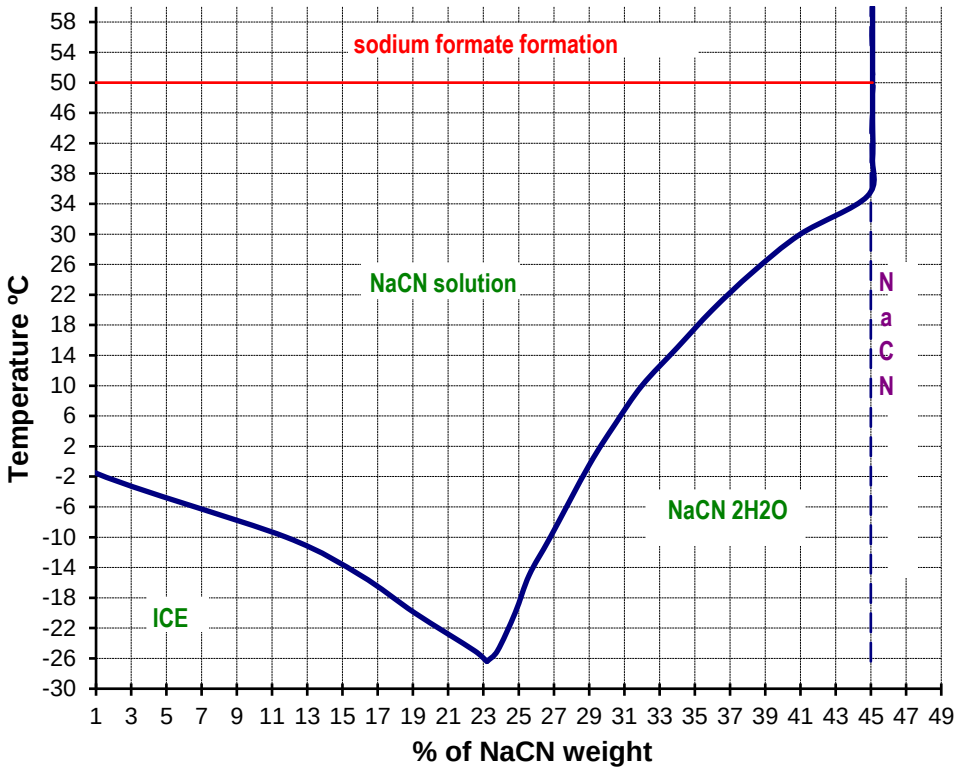
Signature of Lead Auditor

21/01/2024 — Date

In order to avoid the presence of NaCN crystals: In accordance with the NaCN solubility curve, the 43,54% concentration is very close to its own solubility curve at the operation temperature. In order to avoid the compound's precipitation during this phase, the recommendation is to work with NaCN solution at a concentration of approximately 42%, since this will ensure the solubilized form of the NaCN.

6

NaCN Solubility Curve in H_2O



Circuit Description**:**

This section is basically formed by:

- One evaporator (VP 230.01)
- One crystallizer (CR 230.01)
- Ejectors (J 230.02/03)
- Condensers (P 230.02/10/03 and TQ 230.08)
- Pumps

The evaporator is maintained under vacuum (30 mmHg Abs) in order to guarantee the low vaporization temperature (approximately 44^{0}C) so that formation of the sodium formate can be avoided.

Proquigel Candeias — Name of Producer

Signature of Lead Auditor

21/01/2024 — Date

The evaporator is equipped with a tubular bundle where water vapor at 0.2 Kg/cm^2 is injected, thus promoting evaporation of the water contained in the solution It is physically installed above the crystallizer and is interconnected by means of a tube (which forms the barometric leg) containing the NaCN saturated solution. It holds the saturated NaCN solution and the crystals formed in the evaporator by density differential are then sent to the crystallizer.

The main undesirable condition during this phase is the crystal thinning and this condition is basically caused by:

a) High differential between the feed stream temperature and the internal temperature in the evaporator (max 2^{0}C): when the temperature in the feed stream is too high in relation to the internal temperature in the evaporator, there will be excessive “flashing” of the solution inside the evaporator. This will lead to the production of many cores besides the excessive agitation of the solution, which will cause thinning of crystals due to breaking or abrasion.

b) Excessive vapor in the tubular bundle: excessive vapor will cause the concentration in the saturated liquid to reach the super saturation zone, thus leading to excessive spontaneous nucleation.

c) High crystal concentration in the crystallizer: the starting cause of the elevation of crystal concentration in the crystallizer is essentially the lack of balance caused by the difference between the amount of crystals produced and the withdrawal of the product in the centrifuge. As seen before, the production of crystals is a direct function of the vapor supplied to the evaporator bundle. This leads us to the conclusion then that the control of two parameters is vital, so the system does not become unbalanced.

When it undergoes evaporation, the solution is super concentrated and when its “discharges” the crystals it goes back to the point on the solubility curve. The concentration differential will be the amount of crystals produced. In this phase it is important to keep the point below the zone of super saturation, since in this condition there will be excessive spontaneous nucleation and, as a consequence, the crystals formed will be too thin. This is due to the fact that that all of the energy in the system will be used in the formation of nuclei, and growth energy will be consumed.

Separation: During this phase, the crystals produced are transferred from the crystallizer to a decantation tank (TQ 230.10) thus undergoing a first separation phase. The bottom product in tank TQ 230.10, which has got a high concentration of crystals is continuously fed to one of the centrifuges (CT 230.01 or 02), in a way that the solid product resulting from the separation contains 6 to 8% of humidity. The liquid product is the mother liquor which contains the thin crystals from separation. It is sent to the lung tank in the unit (TQ 230.05) for dissolution of thin crystals and subsequent recycling.

Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date

SUMMARY AUDIT REPORT

Transfer of the crystallizer to decantation tank TQ 230.10 should not agitate it, since that will cause crystals to return to the crystallizer by means of the tank overflow. This might cause break and thinning of crystals that have already been formed and separation in the centrifuge will be more difficult.

Auditor's Finding

This operation is:

X in full compliance
□ in substantial compliance *****(see below)
□ not in compliance

with the International Cyanide Management Code.
During the previous three years certification cycle, Proquigel Candeias did not experienced no significant cyanide related incidents, nor any compliance problems related to cyanide production management.

***** The Corrective Action Plan to bring an operation in substantial compliance into full compliance must be enclosed with this Summary Audit Report. The plan must be fully implemented within one year of the date of this audit.

Audit Company: NCABrasil Expert Auditors Ltd. (www.globalsheq.com)
Acting Audit Team Leader: Celso Sandt Pessoa
E-mail: celsopessoa@ncabrasil.com.br (ICMI qualified lead auditor and TEA since 2006).
Names and Signatures of Other Auditors: not applicable.

Date(s) of Audit: 08/03 ~ 17/03/2023 (on-site) and 30~31/05/2023 (off-site)

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 certification audit. I further attest that the certification audit was conducted in a professional manner in accordance with the International Cyanide Management Code Verification Protocol for Cyanide Producer Operations (June 2021) and using standard and accepted practices for quality assurance, health, safety and environmental audits.

Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date

SUMMARY AUDIT REPORT

Principle 1 | OPERATIONS

Design, construct and operate cyanide production facilities to prevent release of cyanide.

Production Practice 1.1: Design and construct cyanide production facilities consistent with sound, accepted engineering practices and quality control/quality assurance procedures.

The operation is:
- **X** in full compliance with
- ☐ in substantial compliance with Production Practice 1.1
- ☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

The operation maintains a technical library with the design and construction documentation related to the operation facilities (initial and new ones). Sampled technical documentation related to tanks and reactors from process units U230 and U233. The operation bought a new backup reactor from Foosung Hantech Ltd. (South Korea). All design, fabrication, inspection and testing documentation (data-books) were retained by the operation and were reviewed in this opportunity. The commissioning records of the operation facilities are retained by the operation and the initial and new installation were reviewed approved by qualified engineers. Basically pipelines, tanks and reactors were constructed with carbon steel and austenitic stainless steel, in accordance with American Petroleum Institute, American Society of Mechanical Engineers and American Society for Testing Materials specifications. There are interlock systems in all process units, mainly related to control the caustic soda flows to the reactors. All operation facilities are managed and monitored from the control room. Shutdown buttons are available in specific places at the process plant, as evidenced during the field audit. All process tanks, reactor and pipelines are inside concreted secondary containments, which are included in the preventive maintenance plan and as evidenced during the field audit. All monitoring and alarm instruments, such as level and alarm sensors, HCN detectors and alarms are included in the preventive maintenance system and inspected and calibrated on a regular basis. Reviewed maintenance, inspection and calibration records for level sensors and for HCN detectors. All process tanks can be fulfilled up to 90% of their volume (then the pumping system is shut down), but alarm 1 level is set for 80%. Related to the fulfilling of the isotanks with cyanide solution, this operation is performed by the control room operators and the isotanks are fulfilled up to 80% of its volume. The fulfilling activity is interrupted automatically when this value is reached. At the same time, a second operator, at field, is monitoring the fulfillment of the isotank and, if necessary, there is a shutdown button that interrupts automatically the fulfillment of the isotank. All secondary containments are constructed of structural concrete with 115% of the volume of the biggest tank inside and considering the design storm event, as evidenced in the design documentation. During the field audit, it was evidenced that all the secondary containments are kept clean and empty. The process pipelines are covered with polyurethane foam and stainless-steel foil and, in most of the cases, are inside the secondary containments, when containing liquid cyanide solution, as evidenced during the field audit and at the as built documentation (process units U230, U235 and U233). All cyanide solution is stored in closed carbon steel tanks, as evidenced in the fabrication documentation and during the field audit.

Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date

Solid cyanide boxes are stored inside a specific warehouse, under roof, over pallets, on concreted floor, with natural ventilation where no other materials are stored. All tanks are installed in open areas, with natural ventilation, as evidenced during the field audit. All process plant perimeter is fenced, and the access is controlled and only allowed personnel have access to the process plant, as evidenced during the field audit. Cyanide solution is kept stored inside closed carbon steel tanks, which provides an excellent barrier to avoid the contact the cyanide solution with other materials. It is important to note that no other materials are stored inside the secondary containments where the cyanide containing tanks are placed.

Production Practice 1.2: Develop and implement plans and procedures to operate cyanide production facilities in a manner that prevents accidental releases.

The operation is:

X in full compliance with
□ in substantial compliance with Production Practice 1.2
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

It was evidenced that the operation developed, documented, implemented and maintains a production group of procedures and plans (eg: CNS-Q-02(6) and MP-PRO-CNS-391-001(7)) and associated work instructions. Please refer to section 6 of this report. The production procedures and plans address non-standard operating situations and how to manage them. The operation developed, documented, implemented and maintains a change management procedure (NO-SGI-013(10)) where all proposed changes must be reviewed and approved (or not) by a multidisciplinary team which includes representatives of the environmental, occupational health and safety processes. It was evidenced one case of change management process. The operation developed, documented, implemented and maintains a preventive maintenance program. Reviewed preventive maintenance plans and associated records for the following equipment: R233-01 (reactor), B233-01A/B, B233-04A/B, B230-01A/B and B235-01A/B (pumps), TQ-220-05B, TQ-220-11, TQ-220-14 and TQ-230-01 (tanks). All process instrumentation (e.g: sensors, transmitters, detectors) is included in the maintenance and calibration management system, as previously mentioned. Related to the preventive maintenance of equipment used to move isotanks and sea containers (cranes and forklift) as well as to move solid cyanide boxes (forklift) there are different protocols. The port operator (Graciano Ltd.) is the owner of the crane and the forklift. An annual preventive maintenance is maintained by this port operator. The reviewed isotanks and sea containers (rented by Graciano Ltd.) are certified by Bureau Veritas Brasil Ltd. and maintained by Graciano Ltd., on an annual basis. All isotanks and sea containers are annually inspected and certified by Bureau Veritas Brasil Ltd. The Candeias operation rents the forklift (from LAmorim Ltd) used to move the solid cyanide boxes inside the operation warehouse and to load cyanide boxes inside the sea container. An annual preventive maintenance is kept by LAmorim Ltd. and monthly inspections are performed in order to ensure that the forklift is working in conformance with its technical specifications. All production facility is managed and monitored through a DCS system (Distributed Control System), all digital, which includes production parameters such as pressure, temperature, flows, tank level, pH, HCN level, valve system, interlock system, among other aspects. This system works 24 hours and several alarms (visual and sound) and sensors. All process instrumentation is included in the preventive maintenance and calibration program as previously mentioned.

Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date

All effluent (e.g: water from washing, rainwater) retained at secondary containments are directed to a wastewater treatment tank, where this effluent is treated and then sent to CETREL treatment plant (Camaçari petrochemical complex treatment plant). All cyanide contaminated material (real or potential) are packed, identified and sent to a qualified environmental services supplier and incinerated. Cyanide solution certified iso-tanks or iso-containers are clearly identified according to Brazilian legislation. Reviewed the following iso-tanks (all certified by Bureau Veritas Brasil): TCVU-361663-6, TCVU- 361658-0, TCVU-366114-7 and TCVU- 961035-8. Solid NaCN is packed in accordance with Brazilian and international standards, inside a plastic bag, which is inside a big bag and finally inside a wooden box. In both cases, safety and environmental signage and pictograms are placed and the product adequately labeled, as evidenced in the field audit.

11

Production Practice 1.3: Inspect cyanide production facilities to ensure their integrity and prevent accidental releases.

The operation is:

X in full compliance with
□ in substantial compliance with Production Practice 1.3
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

All cyanide containing tanks are inspected on a daily basis by the operational team and monthly by the maintenance team. All secondary containments are inspected on a daily basis by the operational team and monthly by the maintenance team. All pipelines, pumps and valves are inspected on a daily basis by the operational team and monthly by the maintenance team. The operation has an integrated inspection protocol (one for the operational team and another to the maintenance team), where such inspections are made together. All iso-containers (used to transport cyanide solution) are inspected and neutralized by a qualified supplier after returning from a delivery to a mining operation. According to my professional experience, as a mechanical engineer, the defined inspection frequencies are adequate to ensure that that facilities are working within the design parameters. During the field audit, it was evidenced that the operation facilities are well maintained. As previously mentioned, there are specific inspection protocols, addressing the quality aspects to be inspected, by the operational team and by the maintenance team. All corrective maintenance orders, resulting as an output from the inspections, indicates the corrections and corrective actions to be implemented. All corrective maintenance orders records are retained by the operation. Reviewed corrective maintenance orders issued between 2020 and 2023.

Proquigel Candeias — Name of Producer
Signature of Lead Auditor
21/01/2024 — Date

SUMMARY AUDIT REPORT

Principle 2 | WORKER SAFETY

Protect workers' health and safety from exposure to cyanide.

Production Practice 2.1: Develop and implement procedures to protect facility personnel from exposure to cyanide.

12

The operation is:

X in full compliance with
□ in substantial compliance with Production Practice 2.1
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

It was evidenced that the operation developed, documented, implemented and maintains a production manual and associated work instructions. The production manual and associated work instructions addresses non-standard operating situations and how to manage them. All reviewed operational work instructions (or safe work procedures) address pre-work activities, such as inspection of collective protective equipment, personal protective equipment, tools, handling/ transport resources, among other aspects. The required personal protective equipment (e.g: overall, full face masks, boots, gloves, HCN detectors, among others) that must be used to perform that specific task. It was also evidenced that the operation developed, documented, implemented and maintains an Emergency Response Plan (ERP). Please refer to Principle 5. The operation developed, documented, implemented and maintains a preventive maintenance program. There are specific documented protocols to be followed by the operational team to prepare a facility to be maintained, including neutralization and liberation of such facility to the maintenance team to work. The production manual and its associated work instructions was developed by a multi-disciplinary team, led by the production team, but involving other processes such as environmental management and occupational health and safety teams. The operation identified areas where HCN may exist in an in an instantaneous or continuously basis. Such places are monitored and calibrated HCN detectors installed. The operation has a specific documented procedure to identify hazards and analyze risks and such procedure is used as a basis to develop operational procedures and identify potentially risky areas or activities. Related to the monitoring of NaCN dust, the operation installed two types of air sampling pumps (fixed for the work environment) and portable for the workers (Gillian GilAir multi-flow). The focus is to monitor the Total Weight Average (TWA) in the work environment and on the works. All evidenced monitoring results showed that the results are below the Permissible Exposure Limit (PEL), in accordance with Brazilian and NIOSH (National Institute for Occupational Safety and Health) standards. All operators use safety masks with ABEK1HgP3 filters. The operation installed HCN detectors in such places where alarm 1 is set for 2.5 ppm (alarm sounds at control room) and alarm 2 is set for 4.5 ppm (operators must leave the area). Reviewed maintenance and calibration records for HCN detectors 391-AIT-235-001, 391-AIT-220-001, 391-AIT-230-001, 391-AIT-230-002 and 391-AIT-230-003. All plant operators have radios and are in touch with the control room. CCTV (closed circuit television) system is also available, and monitoring of the areas is made from control room. Both systems were evidenced during the field audit. According to the Brazilian legislation, all employees must pass an annual occupational health evaluation and obtain a permit (ASO = Atestado de Saúde Ocupacional) to be allowed to work. The annual occupational health evaluation scope includes clinical analysis (e.g: blood and urine), lung, heart, liver, kidneys and eyes evaluations, audiometry evaluation and effort tests, in accordance with Brazilian legislation.

Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date

Reviewed ASO records from plant and maintenance teams. There is a clothing policy in the operation where people leaving such areas must change their clothes or disposable overall into identified plastic bags and disposed for washing or incineration. The number of operators transiting in the process plant is very low. The plant facilities are richly identified related to the presence of cyanide and the mandatory personal protective equipment that must be used, as evidenced during the field audit. Such kind of signage (smoking, eating, drinking, and open flames is prohibited) is available is several places at the process plant, as evidenced during the field audit.

Production Practice 2.2: Develop and implement plans and procedures for rapid and effective response to cyanide exposure.

The operation is:
X in full compliance with
□ in substantial compliance with Production Practice 2.2
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

The operation developed specific written emergency response plans and procedures to respond to cyanide exposures (please refer to Principle 5). It was evidenced during the field audit that the operation installed and maintains, in several places, emergency showers and low pressure eye-washers (to avoid the eyes to be hurt by high pressure water jet), that are inspected and maintained in a routine basis and were tested during the field audit, all operational. It was also evidenced that the operation installed ABC type (dry chemical powder) fire extinguishers in different places in the process plant. These fire extinguishers are maintained in accordance with the Brazilian legislation and the Military Firefighters of Bahia State by a qualified maintenance supplier. Records of such maintenance are retained by the operation and were reviewed during this opportunity. It was evidenced the operation dispose oxygen bottles in the vicinity of emergency showers and eye-washers. Beyond that, the operation has a full operation ambulatory equipped with oxygen bottles, oximeters, resuscitator, AED (Automatic External Defibrillator), ambu (Artificial Manual Breathing Unit), antidotes (sodium thiosulfate, sodium nitrite and methylene blue), diphoterine, radio, telephone, ambulances and a medical team (two nurses and a doctor (toxicologist)). All evidenced during the field audit. The operation developed, documented, implemented and maintains an inspection program related to first aid hardware and resources, including drugs (antidotes´ expire date). All antidotes are stored inside their original packs (foam boxes), inside plastic boxes. The ambulatory temperature is controlled and kept around 21C (+ - 2C). Depending on the resource, the inspection frequency may be daily, weekly or monthly. Records of such inspections are retained by the operation and were reviewed during this audit. Inspections are performed by the ambulatory nurses and security team (ambulances testing). Safety data sheets and first aid procedures (intoxication and chemical burning) are available in different places at the operation, all in Portuguese, as evidenced during the field audit. All cyanide containing installation (tanks, pipelines, containers) are clearly identified. The cyanide flow is clearly marked in the pipelines, as evidenced during the field audit. The operation installed a washing station in the exit of the process plant (and in other places). Before leaving the process plant it is mandatory to wash your safety boots and, as previously mentioned, change your uniform or overall. The operation has a full-equipped ambulatory, as previously mentioned. The operation has three ambulances (advanced life support configuration) to transport stabilized victims to the Camaçari petrochemical complex hospital or to São Rafael hospital in Salvador city.

Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date

As previously mentioned, the operation has formal agreements with São Rafael Hospital and the Camaçari petrochemical complex hospital. The operation documented and implemented a procedure ((NO-SGI-005(16)) to investigate real and potential incidents. There were no cyanide related incidents in the operation in the last three years.

Principle 3 | MONITORING

Ensure that process controls are protective of the environment.

Production Practice 3.1: Conduct environmental monitoring to confirm that planned or unplanned releases of cyanide do not result in adverse impacts.

The operation is:
- **X** in full compliance with
- □ in substantial compliance with Production Practice3.1
- □ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

The operation developed, documented, implemented and maintains a Water Resources Management Program (which was developed by environmental/ chemical engineers and technicians and reviewed and approved by the environmental process manager), which includes the monitoring of surface waters (sea) and underground waters. The plan addresses the places were the samples shall be taken, the number of samples (in accordance with the operation environmental permit), the types of cyanide to be analyzed (total and free). All samples are collected by CETREL technicians and CETREL protocols clearly describe the sample preservation and transportations methods. Chain of custody records are left at the operation addressing all the previous mentioned information. The operation does not have direct discharges to surface waters. All operation effluents are treated inside the operation (with sodium hypochlorite) and then sent (by truck) to an external treatment, at Proquigel Camaçari plant and then sent to a final treatment plant (CETREL manages this effluent treatment plant), which treats all the Camaçari petrochemical complex effluents, before final disposition at the sea (under water discharge). Rainwater is discharged, after treatment at CETREL, at the Capivara Pequena creek, which is monitored, up and down stream by CETREL, all in accordance with the operation environmental permit. All monitoring results, between 2020 and 2023, for total cyanide were below 0.005 mg/l (not detectable). Although the operation does not have a direct discharge to the sea, they monitor the sea water quality (total cyanide and free cyanide) in ten different points and in different depths, twice a year. Reviewed CETREL monitoring reports, between 2020 and 2023 and the highest value for total cyanide was 0.235 mg/l and all values for free cyanide were below 0.005 mg/l (not detectable). CETREL laboratory is an ISO 17025/2017 certified and accredited laboratory by Inmetro Brasil (Instituto Nacional de Metrologia). As previously mentioned, the operation monitors the sea water quality (total cyanide and free cyanide) in ten different points and in different depths, twice a year. Reviewed CETREL monitoring reports, between 2020 and 2023 and the highest value for total cyanide was 0.235 mg/l and all values for free cyanide were below 0.005 mg/l (not detectable). CETREL laboratory is an ISO 17025/2017 certified and accredited laboratory by Inmetro Brasil (Instituto Nacional de Metrologia). The underground water could be used by the operation as industrial water, but the operation does not use groundwater for any purpose. The operation buys treated water from the municipality of Candeias. Anyway, the operation monitors the underground water quality (through CETREL laboratory).

Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date

Samples are taken from water wells available at the operation and all values for total cyanide, between 2020 and 2023, were below 0.005 mg/l (not detectable). Between 2020 and 2023 there were no impacts, caused by cyanide, on underground waters. The beneficial use of groundwater is preserved by the operation. The operation has two points of emissions (at process unit U225 and U230). The highest value for HCN, in the last three years, was 0,233 mg/Nm3. The acceptance criteria for this aspect is 7,0 mg/Nm3 according to Brazilian environmental standard CONAMA (Conselho Nacional de Meio Ambiente) 316. All monitoring frequencies are in accordance with the Brazilian environmental legislation and the operation environmental permit.

Principle 4 | TRAINING

Train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner.

Production Practice 4.1: Train employees to operate the facility in a manner that minimizes the potential for cyanide exposures and releases.

The operation is:

X in full compliance with
□ in substantial compliance with Production Practice 4.1
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

The operation developed and implemented two induction programs, both addressing cyanide related risks, where the first one is mandatory to all employees and contractors entering the operation. The second one, entitled Cyanide Basic Training, is an integration training for those, who passed the induction training, that will work in the process plant. In both cases, the training effectiveness is verified through a written examination. Both training programs are refreshed every two years. During this audit, records of such trainings (initial and refresh) performed between 2020 and 2023 were reviewed. For all employees and contractors, it is mandatory to be trained in the use of escape masks, that must be used everywhere in the operation. This is the first PPE related training that everyone entering the operation receives. For those employees and contractors that will work in the process plant, there is a second training session focused on the PPEs that must be used in the process plant. The third one is for those who will act in emergency situations, where specific PPEs must be used. In all cases, the training effectiveness is verified through a written examination and observations. During this audit, records of such trainings (initial and refresh) performed between 2020 and 2023 were reviewed. All PPE related trainings are in conformance with Brazilian legislation (NR-6/ Norma Regulamentadora-6). Such trainings are refreshed every two years. All workers that will work with cyanide must pass through an “on the job” training program (theoretical and practical), which includes the training in the operational procedures and safe work procedures. The trainee receives practical training under the supervision of qualified workers (operators and supervisors) and, if approved, they will work under supervision for three months, before being allowed to work alone. Such operational training program is refreshed every two years. Records of such trainings were reviewed during this audit. All workers that will work with cyanide must pass through an “on the job” training program (theoretical and practical), which includes the training in the operational procedures and safe work procedures. The trainee receives practical training under the supervision of qualified workers (operators and supervisors) and, if approved, they will work under supervision for three months, before being allowed to work alone. Such operational training program is refreshed every two years. Records of such trainings were reviewed during this audit.

Proquigel Candeias — Name of Producer
Signature of Lead Auditor
21/01/2024 — Date

The “on the job” training program (theoretical and practical), includes the training in the operational procedures and safe work procedures. The “on the job” training program (theoretical and practical), includes the training in the operational procedures and safe work procedures. The trainee receives practical training under the supervision of qualified workers (operators and supervisors). The effectiveness of all mentioned training programs is verified through written examinations and observations, as previously mentioned.

16

Production Practice 4.2: Train employees to respond to cyanide exposures and releases.

The operation is:
X in full compliance with
□ in substantial compliance with Production Practice 4.2
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

All plant operational team is trained on cyanide related emergency situations, including releases to the environment and exposures to cyanide. All plant operational team is trained on cyanide related emergency situations, including releases to the environment and exposures to cyanide. All provided training is recorded and retained by the operation. The training records identify the trainee, the instructor, the training date, the training scope and the trainee performance. Reviewed training records for three new employees contracted in 2023 and one new employee contracted in 2023. The job rotation in the operation is very low. Also evidenced refresh training records performed between 2021 and 2023.

Principle 5 | EMERGENCY RESPONSE

Protect communities and the environment through the development of emergency response strategies and capabilities.

Production Practice 5.1: Prepare detailed emergency response plans for potential cyanide releases.

The operation is:
X in full compliance with
□ in substantial compliance with Production Practice 5.1
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

It was evidenced that the operation developed and maintains an emergency response plan/ERP (PP-SGI-SIN-391-008(2), updated in 08/ March/2023). It was also evidenced that the operation is also covered by the Camaçari´s Petrochemical Complex emergency response plan, entitled PAM (Plano de Auxilio Mútuo). The emergency response plan (ERP) considers the following scenarios: Catastrophic release of hydrogen cyanide, releases of liquid cyanide during packaging, storage, loading and unloading operations, releases during fires and explosions, pipe, valve and tank ruptures, power outages and equipment failures and overtopping of ponds, tanks and waste treatment facilities. The ERP was developed by a multi-disciplinary team, including plant operators and supervisors, control room team, maintenance team, environmental experts, occupational safety experts and the medical team.

After a risk evaluation, all potential emergency scenarios were identified and specific responses for each scenario were defined. Evacuation plan for internal and external stakeholders (Candeias´ community) is clearly defined by the operation. There are specific first aid protocols related to cyanide intoxication, that includes the use of antidotes and for chemical burning. The emergency response team is composed of plant operators and maintenance technicians. All responses related to cyanide releases involves the emergency response team, the control room team and the maintenance process team. The operation also has interlock systems, that shutdown the process plant in the event of cyanide release during processing. The emergency response plan addresses specific actions, according to the emergency scenario, that shall be implemented to contain, assess, mitigate and prevent future release of cyanide.

Production Practice 5.2: Involve site personnel and stakeholders in the planning process.

The operation is:
X in full compliance with
□ in substantial compliance with Production Practice 5.2
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

The operation ERP was developed by different and multi-disciplinary team including plant operators and supervisors, control room operators, maintenance technicians, occupational safety and health technicians, environmental technicians and brigade members. External stakeholders are involved also, mainly the ones included in the PAM (Plano de Assistência Mútua/ emergency response plan developed to the Camaçari Petrochemical Complex), civil defense of the Candeias´ municipality and military firefighters of Bahia State. External stakeholders such as other operations installed in the Camaçari petrochemical complex and the civil defense of Candeias´ municipality are aware about the operation emergency response plan (ERP). Such stakeholders are informed directly by the operation planned meetings and participation on emergency response drills.

Production Practice 5.3: Designate appropriate personnel and commit necessary equipment and resources for emergency response.

The operation is:
X in full compliance with
□ in substantial compliance with Production Practice 5.3
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

The operation designated two emergency response coordinators (Environmental, Occupational Health and Safety Coordinator and Manager) with corporate authority to provide the necessary resources to implement the emergency response plan. The operation has a specific and qualified emergency response team. The operation emergency response team is trained and qualified in accordance with Brazilian legislation and technical specifications developed by the Military Firefighters of Bahia State. Annually, the emergency response team receives a planned refresh training, in accordance with the Brazilian legislation. Records of both trainings' sessions are retained by the operation and were reviewed during this opportunity. There is an annex in the ERP addressing all contact information related to the emergency response team and with the external stakeholders that may be necessary to participate in the emergency response.

Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date

There is a WhatsApp group related to the emergency response team and coordinators. The responsibilities and authorities of the emergency response coordinators and the emergency response team are clearly defined. In another ERP annex there is a master list of all resources available to the emergency response team. Monthly all the available resources to the emergence response team are inspected. Records of such inspections are retained by the operation and were reviewed during this audit. During the field audit, it was evidenced that such resources are kept in order and in good condition and are promptly available to be used. As previously mentioned, all external stakeholders (PAM members, civil defense, military firefighters, hospitals) duties are clearly defined in the ERP. As previously mentioned, all external stakeholders' duties are communicated in planned meetings and during the participation of emergency drills.

Production Practice 5.4: Develop procedures for internal and external emergency notification and reporting.

The operation is:
X in full compliance with
□ in substantial compliance with Production Practice 5.4
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

As previously mentioned, there is an annex in the ERP addressing all contact information of internal and external stakeholders that are involved with emergency response activities. ICMI contacts are informed in the ERP. There were no cyanide related emergencies in the last three years.

Production Practice 5.5: Incorporate remediation measures and monitoring elements into response plans and account for the additional hazards of using cyanide treatment chemicals.

The operation is:
X in full compliance with
□ in substantial compliance with Production Practice 5.5
□ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

All cyanide containing tanks are installed inside secondary containments (concreted) with sumps and floor pumps, as evidenced during the field audit. Neutralization protocols are based sodium hypochlorite solutions (12%), available in containers in the process plant, also evidenced during the field audit. All contaminated materials are neutralized and disposed into plastic bags and send to incineration as a final disposition (at CETREL). The operation has a contract with a mineral water supplier (drinking water) and has its own water wells to provide water for domestic use, which are transported by tank trucks. The operation´s emergency response plan clearly addresses that the use of chemicals products such as sodium hypochlorite, ferrous sulfate and hydrogen peroxide, to neutralize cyanide that was released into surface water or could be expected to enter surface water, is forbidden. The operation environmental monitoring plan includes the mandatory environmental monitoring that must be performed in the event of emergencies. The emergency environmental monitoring plan addresses the parameters to be monitored, the acceptance criteria and the sampling methods.

SUMMARY AUDIT REPORT

Production Practice 5.6: Periodically evaluate response procedures and capabilities and revise them as needed.

The operation is:
X in full compliance with
□ in substantial compliance with Production Practice 5.6
□ not in compliance with

19

Summarize the basis for this Finding/Deficiencies Identified:

The emergency response plan is reviewed and evaluated after real or potential emergencies and after planned emergency drills. The operation annually establishes a mock emergency drill program. In 2020 there were no emergency drills due to the Covid 19 pandemic situation. In 2021, the operation performed three emergency drills. In 2022 the operation performed two emergency drills. In 2023 performed one emergency drill. There are two more emergency drills planned to be performed in 2023. The emergency response plan is kept updated and is reviewed after real or potential emergencies and after emergency drills. The emergency response plan was updated in 10/February/2023, after one emergency drill. All emergency drills planning includes cyanide leakages and/or cyanide exposures scenarios.

Audit team conclusions:

Based on the sampled evidences, reviewed documented procedures, records, drawings, data sheet, the physical conditions of the site (installations), in the interviewed personnel, the audit team concludes that the cyanide management system is FULLY implemented and maintained in accordance with the Cyanide Producers Verification Protocol for the International Cyanide Management Institute – ICMI dated June 2021. Being usual in all audit process, through sampling, opportunities of improvement (corrective and preventive) may exist and were not identified in this opportunity.

Celso Sandt Pessoa
Rio de Janeiro, RJ, Brasil, 21/01/2024.

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Proquigel Candeias		21/01/2024
Name of Producer	Signature of Lead Auditor	Date