SUMMARY AUDIT REPORT

Cyanide Production Operation
Summary Audit Report

for

Proguigel Química S/A

Candeias Unit/ 2016

Prepared by NCABrasil Expert Auditors Ltd.
SUMMARY AUDIT REPORT

Instructions

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.

Name of Producer: UNIGEL – CANDEIAS UNIT
Name of Producer Owner: PROQUIGEL QUIMICA S/A
Name of Producer Operator: PROQUIGEL QUIMICA S/A
Name of Responsible Manager: Deiviti Caetano
Address: Fazenda Caroba s/n, Candeias, Bahia State.......Country: Brasil
Telephone: (55) 71-38786532
Fax: (55) 71-38786532
E-mail: deiviti.caetano@unigel.com.br
Location detail and description of operation:

Proquigel Candeias Unit has its plant within the petrochemical complex in Candeias, an city located in Bahia, in northeastern Brazil. It is 50 kilometers far from Salvador the capital of the state of Bahia and 30 kilometers far from Camaçari Industrial Complex which was the first planned petrochemical plant in Brazil. The access is by a very good 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%, we 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 + H₂O (exothermic reaction), the mixture temperature rises about 10°C 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:
  \[ \text{HCN} + \text{NaOH} \rightarrow \text{NaCN} + \text{H}_2\text{O} \]
  \( (27) \quad (40) \quad (49) \quad (18) \)
  - This is an exothermic reaction and it releases: 7.45 Kcal/mol HCN or 152 Kcal/kg NaCN.
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The temperature increase accelerates a secondary reaction for the formation of sodium formate and ammonia. The temperature during the synthesis should not exceed 55°C, so that the formation of these impurities is not accelerated.

\[ \text{HCN} + \text{NaOH} + \text{H}_2\text{O} \rightarrow \text{HCOONa} + \text{NH}_3 \]

(27) (40) (18) (58) (17)

- Due to the presence of SO2 as a stabilizer of the hydrocyanic acid we will also have the following reaction:

\[ \text{SO}_2 + 2\text{NaOH} = \text{Na}_2\text{SO}_3 + \text{H}_2\text{O} \]

SO2 + 2 NaOH \rightarrow Na₂SO₃ + H₂O

(64) (80) (126) (18)

c) Process description:

- Hydrocyanic acid (HCN) is fed to a mixer (ventur 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 of 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 exhaust system/chimney.
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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.

- **Reactions of the atmospheric air CO₂ with NaCN and NaOH:**
  
  \[
  2\text{NaCN} + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{Na}_2\text{CO}_3 + 2\text{HCN}
  
  2\text{NaOH} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}
  \]

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

- **Sodium formate formation:**

  \[
  \text{NaCN} + 2\text{H}_2\text{O} \rightarrow \text{HCOO}\text{Na} + \text{NH}_3
  \]

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

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.
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°C) so that formation of the formate can be avoided. The evaporator is equipped with a tubular bundle where water vapor at 0.2 Kg/cm² 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 saturate solution. It holds the saturated NaCN solution and the crystals formed in the evaporator by density differential are then sent to the crystallizer.
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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°C): when the temperature in the feed stream is too high in relation to the internal temperature in the evaporator, there will be excessive “flushing” 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 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 it "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 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. 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.
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Auditor's Finding

This operation is:

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

with the International Cyanide Management Code.

In the last three years the operation faced one case of HPI (high potential incident), dated 09/06/16, where a contractor worker was exposed to NaCN solution (after washing the process plant) during a maintenance activity. The worker was highly intoxicated and promptly removed to Candeias Municipality Hospital where received adequate treatment. The worker was released from the hospital two days after the real incident. An investigation group was formed, identifying the causes, defined corrective actions (some of them are still being implemented, and others were already implement and found effective). The corrective action management system worked accordingly.

* 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.
Acting Audit Team Leader: Luiz Eduardo Ferreira
E-mail: luizeferreira2015@gmail.com (ICMI qualified lead auditor and TEA)
Names and Signatures of Other Auditors: Cezio Sandt Pessoa (ICMI qualified lead auditor and TEA/ IRCA UK qualified Principal Auditor A009245)

Date(s) of Audit: 28/03/2016 – 02/09/2016, 05–07/12/2016 (on site); 08–09/12/2016 (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 verification audit. I further attest that the verification audit was conducted in a professional manner in accordance with the International Cyanide Management Code Verification Protocol for Cyanide Producer Operations and using standard and accepted practices for health, safety and environmental audits.
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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

☑ In full compliance with Production Practice 1.1
☐ In substantial compliance with
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

Evidenced that Proquigel established, implemented and maintained a quality control and quality assurance programs for new and existing cyanide facilities and modifications. Standards drawings were reviewed and found duly implemented. It is clearly defined and documented material requirements for each piping system used on the project and specified all applicable standards, codes and technical specifications including piping Material Specifications with ANSI Standard flanges, line identification, index of piping classification, material specification sheets piping. It is defined that all piping materials shall conform to the requirements of the most current applicable Standards and in the material specifications such as NR 13 / API 510 – Pressure Vessel Inspection Code; API 570 – Piping Inspection Code; ASME B31.1 – Power and Process Piping; ASME B31.3 – Process Piping; ASME B31.8 – Training Resources; API 620 – Design and Construction of Large Welded Low Pressure Storage tanks; API 650 – Welded Steel Tanks for Oil Storage; API 653 – Tank Inspection, Repair, Alteration and Reconstruction.

Evidenced that ET-000-21-10.1 which clearly defines the materials that shall be used is duly established, implemented and maintained. Sampled examples were: Sulfuric acid – carbon steel; Hydrochloric acid – carbon steel; Sodium hydroxide – carbon steel; Sodium cyanide – 304 L stainless steel. During the audit, several QC and QA records related to construction of cyanide production and storage facilities were assessed and found to be in place. Evidenced that Proquigel retains all records of quality control and quality assurance for cyanide facilities as required.

Competence records such as training, education, experience and ability records of personnel involved with QC and QA matters were reviewed and found to be adequate. Proquigel presented all required documentation related to QC/QA documentation and records. Evidenced documented operational instructions CNT.121 – “Interlock system in Units 230 and 235” and CNS.108 – “Interlock system in Unity 233 duly established, implemented and maintained. Records assessed provided evidenced that interlocks are adequately implemented.

Observed in the field audit, that all cyanide tanks have containment dikes and are located on a concreted area. All facilities have been constructed with using concrete. "Technical Report" issued by Coolinsp which states that all cyanide areas were constructed in concrete area and is adequate to prevent and minimize seepage to the subsurface. The Technical report includes inspections of structures, dikes, floors, basins and pump bases.

Evidenced that Proquigel monitors 24 hours/day its processes through a digital system - DCS (Distributed Control System) that controls and alarms levels, temperature, concentration and pressure. Evidenced that Proquigel established, implemented and maintained internal documented procedure PCS.Q.04 rev.10 that defines the alarm levels in DCS (distributed control system). Evidenced that all of the control systems at their DCS room were operating adequately. Pertinent records evidence that secondary containments are adequate and are in accordance Brazilian laws such as: NBR 13752, NBR 8800, Lei 5907, Decreto 13251, NBR 9575, NBR 279, NBR 9574, NBR 9889. Evidenced that the storage capacity is defined in internal documented procedures MC.PRO.220.10.001, MC.PRO.230.10.001 and MC.PRO.233.10.001 they are in accordance with above-mentioned Brazilian pertinent laws.
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Evidenced that all containments are in accordance with ICMI requirements as well as the Brazilian regulation laws.
During field audit, observed that all cyanide storage tanks have over-fill protection.
Evidenced that spill prevention and containment measures are provided for all cyanide solution pipelines.

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
☑ in full compliance with
☐ in substantial compliance with
☐ not in compliance with

Production Practice 1.2

Summarize the basis for this Finding/Deficiencies Identified:

Evidenced that Proquigel has an extensive system of plans, procedures, instructions and check lists which support management of the integrity of process equipment and its operation in a manner intended to avoid cyanide releases and expostions that are duly established, implemented and maintained.
Evidenced internal documented procedures SEG.NO.13 and SGI.PO.03 that define methodology for MOC – Management on change which are duly established, implemented and maintained. Evidenced that process parameters are monitored with necessary instrumentation and is the instrumentation calibrated according to manufacturer’s recommendations.
Evidenced that Proquigel established internal documented procedures for maintenance activities such as: MAN.P.01 that defines methodology for Maintenance System Management; MAN.P.02 that defines how to perform metrological confirmation for production equipment.
Proquigel established List of Critical equipment related to cyanide production and internal documented procedure MAN.Q.02 “Metrological Confirmation Plan for production equipment”. It is defined that all maintenance activities shall be preceded by performing pertinent Work Permits. Responsibilities of maintenance technical planning, maintenance supervisor, instrumentalist and process operator are clearly defined. It is defined and documented how to remove instrument and how to decontaminate them in order to avoid workers exposition to cyanide. The maintenance activities in Proquigel include corrective, preventive and predictive maintenance. Others internal documented procedures in maintenance were assessed such as: MAN.NO.02, PCS.I.06 and MAN.NO.01. Evidenced that the documentation identify specific items to be observed and include the date of the inspection, the name of the inspector, and any observed deficiencies as well as the nature and date of corrective actions documented, and records retained. Evidenced that procedures are in place and being implemented to prevent unauthorized/unregulated discharge to the environment of any cyanide solution or cyanide-contaminated water that is collected in a secondary containment area. During the field audit evidenced that Proquigel established, implemented and maintained internal documented procedure MEA.P.03 that defines methodology for management of liquid effluents. Evidenced that Proquigel has managed its wastewater in accordance Brazilian regulations laws such as: Lei Estadual Bahia 10431, Decreto Estadual Bahia 11235, Portaria CRA 5210, Portaria CRA 12064 and Portaria CRA 8164. During the field audit and reviewing pertinent records evidenced that Proquigel implemented procedure MEA.P.03 that defines methodology for management of liquid effluents. Evidenced that Proquigel has been managed its wastewater in accordance Brazilian regulations laws.
Proquigel implemented procedure PGRS.MEA.P.05 that defines how to manage cyanide-contaminated solids. During the field audit was evidenced that all cyanide-contaminated solids are identified, handled, storage and disposal in accordance Brazilian environmental laws.
During the field audit evidenced that all cyanide solution is adequately stored in tanks, which are hermetically closed with adequate ventilation as well as final products have been kept in a proper and secure storage area. Evidenced that are adopted all measures to avoid and minimize potential exposure of cyanide to moisture. Besides, it is stored in a closed and secure
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area where public access is prohibited. All cyanide areas have controlled access. Proquigel has an internal documented procedure, ITEC 03 that defines methodology for inspection of cyanide tanks. Pertinent records were assessed and provided evidences that are duly implemented. Evidenced that Proquigel established, implemented and maintained procedures to ensure that cyanide is packaged as required by the political jurisdictions through which the load will pass. Evidenced that internal documented procedure SGI.NO.09 and checklist SGI.O.12 clearly define that all kinds of leakage and spills (large or small) are identified, classified and controlled. Record PRO.A.01 and field audit provided evidences that the above-mentioned are implemented as stated. Proquigel has been operated in conformance with its operation instructions which were written and proper to safety and environment according to its basic design.

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

X in full compliance with

☐ in substantial compliance with

☐ not in compliance with

Production Practice 1.3

Summarize the basis for this Finding/Deficiencies Identified:

Inspections of the integrity of pressure vessels, tanks, pumps, valves, pipelines, secondary containments (addressing structural and corrosion concerns) are undertaken as part of preventive maintenance. Besides, inspections for leaks and housekeeping are performed too. Inspection records were reviewed and found to be in place. Evidenced that inspection frequencies are sufficient to assure that equipment is functioning within design parameters. Evidenced that documentation identify specific items to be observed and include the date of inspection, the name of inspector, and any observed deficiencies. Evidenced that inspection frequencies are sufficient to assure that equipment is functioning within design parameters. The nature and date of corrective actions are documented and pertinent records retained.

2. WORKER SAFETY: Protect workers’ health and safety from exposure to cyanide.

Production Practice 2.1: Develop and Implement procedures to protect plant personnel from exposure to cyanide.

X in full compliance with

☐ in substantial compliance with

☐ not in compliance with

Production Practice 2.1

Summarize the basis for this Finding/Deficiencies Identified:

It was observed that the operation developed, documented, implemented and maintains a SHEQ (safety, health, environmental and quality) management system, in order to adequately manage the identified hazards and evaluated risks. There is a formal hazard identification and risk evaluation procedure (SGI-NO-09 (4)/ corporate), which triggers the necessity to develop, document and implement (through operational training) the standard or safe operational procedures (SOP) for normal or routine activities or tasks, including planned maintenance ones. It was observed during the interview with operators that they actively participate in the development of such SOPs. The same approach is used and was evidenced for the development, document and
implementation of emergency response procedures. For non routine tasks or activities (including maintenance ones), it is mandatory the realization of a pre-task hazard identification and risk evaluation (APR), which must be reviewed and approved by an assigned safety officer before the non routine task is allowed/ released (PNTS/ safe work permit). During the field audit were evidenced several SOPs and APRs. It was evidenced that the operation developed, documented, implemented and maintains a change management system. In the last three years only two processes of change were identified and adequately managed.

The operation utilizes fixed and portable HCN detectors, all set to alarm at 4.5 ppm HCN or NaCN dust. The fixed ones are installed at specifically assigned points were the potential to expose workers above 4.7 ppm exists. They are installed in line and interconnected with the interlock system. Once alarmed, the entire operation shuts down. The fixed and portable detectors are calibrated every six months, by an authorized dealer (TecSonic is a MSA authorized/ qualified representative in Bahia/ Brazil). It was also observed that the portable detectors are systematically calibrated (every six months) and the associated records are kept on file.

The operation identified all points were workers could be exposed to HCN or NaCN dust above 4.7 ppm. An specific SOP defines the necessary PPE that are mandatory to be used in such areas such as full mask breather, Tyvek overall, chemical resistant gloves and boots. Safety signage is available in such areas.

All operational activities in the process plant are monitored through CCTV system from the main control room and all the operators are equipped with radios. HCN detectors are also placed in critical points at the plant, connected to alarms and the interlock system. Evidenced during the field audit that such controls seems to be effective.

Beyond that, the process plant is equipped with emergency response resources such as antides, fire extinguishers, autonomous breathing apparatus, low pressure showers and eye washers, water, absorbent materials.

It was evidenced that the operation designed, implemented and maintains a comprehensive health monitoring system for all workers of the operation on an annual basis. Specific monitoring of urine (tioicinete control) is performed for process plant workers every six months. According to the Brazilian law (NR7), the operation must issue an occupational health certificate (ASO), retaining one copy and delivering another copy to the worker. These certificates states if the worker is able to work in its function or not. In the last three years there were not any case of worker not able to work in the production process.

It was clearly evidenced that the operation defined, implemented and maintains a clothing change policy for all workers, contractors, visitors (like auditors). It was evidenced during the field audit that in the exit of the production area there are specific drums for potentially or really contaminated clothing (tyvek overall, gloves, jackets) must be disposed in this drum and sent to final disposal (incineration). It is mandatory before you leave the production area to wash your boots in a place specifically designed for this purpose. Non contaminated normal production clothing (cotton) are not allowed to leave the operation with workers and are sent to a specific qualified laundry.

The production plant site and surroundings are richly identified with safety and warning signals about the presence of cyanide and showing the necessary PPE to be used.

It was evidenced during the field audit that here are in place comprehensive safety and warning signals and placards, including the ones that is forbidden to eat, drink smoke or have open flames in that area.

**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

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☑ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
It was evidenced that the operation established, implemented and maintains internal documented procedures in order to address potential releases of cyanide that may occur on site or may otherwise require response such as NS.007/95 – Camaçari Petrochemical Pole Contingency Plan.
It was evidenced during the field audit that the operation maintains (as part of preventive maintenance program) low pressure showers and eye washers in the plant, with specific water line for these installations, which were tested during the audit and worked accordingly. It was also evidenced in the process plant several non acidic fire extinguishers, adequately maintained and up to date inspected (monthly inspections) by the occupational safety process.
It was clearly evidenced during the field audit that the operation made available all necessary and mandatory resources for use in the plant like water, oxygen, resuscitator (life pack 500 AED), breathing apparatus, antidote (e.g: amyl nitrate, cyanokit 5 gr), radio, CCTV.
According to SMP (standard management procedure) SOC-1-02-R-03(2), all first aid equipment (FAE) must be reviewed and inspected on a monthly basis. There are several points where these FAE are available, including control room U230, production plant, medical center Proquigel, and analytical laboratory. The inspection is performed by an occupational nurse or by a safety technician that is in charge in the programmed inspection day. Records of such inspections were promptly available.
It was evidenced, during the field audit that all environmental, safety and health related information (SOP, SMP, MSDS, signage, first aid posters) available are written in Portuguese.
It was evidenced during the field audit that cyanide containing installations and equipments are clearly identified and as well as the flow in the piping. Evidenced that process tanks, storage tanks, reactor, containers and piping containing cyanide are duly identified in accordance Brazilian Standards NBR 7197 and NBR 6493, as well as the direction of cyanide flow in piping.
It was evidenced in the system and field audit that the operation has a decontamination operational procedure consisting of strategically placed low pressure showers, eye washers and water hoses. In the event of any suspicious of skin contamination the person must unvested and abundantly washed with water. The access to the production plant is made through a personal magnetic card. Visitors, suppliers and workers are not allowed to stay alone in these areas. Mandatory PPEs must be used in such areas. It is also mandatory, when leaving the process plant area to wash your boots in a specifically designated area. During the field audit, all these procedures were checked and found in conformance. Also evidenced that the medical center of the operation has its own facility to decontaminate any suspicious case and, if necessary, the PAME (Camaçari Complex Medical Center), has also its own facility to perform decontamination procedures, as evidenced during the audit at PAME.
The operation has a well equipped medical center, with all the necessary resources (including an expert doctor in chemical intoxication and a team of qualified nurses), such as AED, all sort of antidotes, O2 installations, decontamination area, among others. If necessary, the operation may use the Camaçari Complex Medical Center (PAME), the Candeias Municipally Hospital (which was audited during this audit) or the São Rafael Hospital downtown Salvador city. Depending on the grade of intoxication, the exposed worker may be transported by ambulance or by helicopter. The operation developed and implement operational procedures to transport potentially or really intoxicated workers to external medical facilities, such as PAME, Candeias Municipally Hospital and São Rafael Hospital.
The operation's expert doctor in chemical intoxication) developed partnership with the Camaçari Complex Medical Center, Candeias Municipally Hospital and the São Rafael Hospital, which are fully equipped and with expert medical team to respond to cyanide
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intoxication. The Doctor also developed response procedures to cyanide intoxication and trained the partners medical team (doctors and nurses) in such procedures. It was evidenced that they now work as emergency response team, as evidenced in the field audit at PAME facilities, the Candeias Municipality Hospital and the operation medical center. The PAME is a branch of the São Rafael Hospital at the Camaçari Complex Medical Center.

It was evidenced that the operation plan, perform, review and implement improvements related to emergency drills. Was reviewed a drill related to the transportation of an intoxicated worker to the PAME Medical Center. All planned objectives were achieved, and it was not necessary to change the emergency response procedure for this scenario.

The operation developed, documented, implemented and maintains management procedures (SGI-NO-03 and SEG-NO-03) in order to record, investigate, define and implement improvement actions (corrective and or preventive) and verify if they were effective or not. In the last three years the operation faced one case of HPI (high potential incident), dated 08/06/16, where a contractor worker was exposed to NaCN solution (after washing the process plant) during a maintenance activity. The worker was highly intoxicated and promptly removed to Candeias Municipality Hospital where received adequate treatment. The worker was released from the hospital two days after the real incident. An investigation group was formed, identifying the causes, defined corrective actions (some of them are still being implemented, and others were already implement and found effective). The corrective action management system worked accordingly.

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.

- X in full compliance with
- □ in substantial compliance with
- □ not in compliance with Production Practice 3.1

Summarize the basis for this Finding/Deficiencies Identified:
The operation has direct discharge to surface waters (São Paulo river), after a treatment process in an internal installation. The operation manages its effluents in accordance with two documented procedures MEA-P-03(4) and PCS-I-05(3).
The operation does not have any indirect discharge to surface water.

The management of groundwater quality is made in accordance with SMP # MEA-P-01(4). There are no acceptance criteria for CNw (WAD cyanide), CNt (total) and CNF (free), in the applicable Brazilian legislation. Anyway, the operation installed 21 (twenty one) monitoring wheels up and down gradient of the plant (along freatic line) in order to monitor the underground water quality. CETREL take samples every six months and performs the analytical tests. Reviewed monitoring reports showing typical results as (only in four wheel CN was detected):

- CNw less than 0,005 mg/l
- CNt less than 0,022 mg/l
- CNF less than 0,005 mg/l

During the last three years there was not any reported seepage that could negatively impact the beneficial use of underground water.

All the HCN pipeline circuit is monitored through HCN sensors and alarm at 4,5 ppm HCN. This system is connected with the interlock system that shuts down the hole operation. This basically a standard operational control. The operation performs annually its emissions monitoring to the atmosphere. The used method is EPA 21 (Determination of Volatile Organic Compounds Leaks). Reviewed monitoring reports and the maximum value observed was 3,97 mg/ Nm3.
SUMMARY AUDIT REPORT

As previously mentioned, the operation has a solid monitoring program for surface and underground waters, and for air emissions.

The monitoring frequencies are in accordance with criteria defined in the environmental permit issued by INEMA, the local EPA. Several monitoring reports and results were reviewed, and found in conformance, and based on that, the established frequencies seems to be adequate to characterize the medium being monitored. Any changes on the monitoring frequencies (air and water), must be reviewed and approved by the local EPA. No cases were evidenced.

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 plant in a manner that minimizes the potential for cyanide exposures and releases.

- X in full compliance with
- □ in substantial compliance with
- □ not in compliance with

Production Practice 4.1

Summarize the basis for this Finding/Deficiencies Identified:

The Human Resources process developed, documented, implemented and maintains a management system focused on the integration and training of all workers (doc ref: ADM-NO-03(23) and ADM-NO-06(17)) that have the potential to face cyanide. The system also defines the refresh training frequency (yearly), for certain subjects (safety basic training, cyanide basic training, PPE basic training). All training is provided through "e-learning" approach, or at class room (no longer usual, but still happens) and the attendees are submitted to tests after the training.

The Human Resources process, in conjunction with the SHE process developed specific training program focused on the use and maintenance of PPE. This training is part of the integration of new workers and also is refreshed for the work force on a yearly basis. Basically through the e-learning platform or at class room. Tests are performed in the end of the training session, in order to ensure that the worker learned and maintain the knowledge about the subject being trained.

The Human Resources process in conjunction with the Production process developed an "on the job training program" for beginners and a refresh session for experienced workers. The initial program takes approximately 3 (three) months and are consisted of technical operational training. The trainee worker is only allowed to work in the production after being approved (by testing and observation) in the on the job training.

The technical-operational training is based on the developed and implemented SOPs. The training elements are clearly identified in the training materials. Occupational health and safety and environmental training materials are developed by the SHE process.

All the assigned training instructors are master supervisors or production coordinators with vast experience in the processes.

SHE related training are provided by SHE technicians, engineers and doctors. The introductory training effectiveness is evaluated by testing. The on the job training effectiveness is evaluated by testing and on the job observation. After that, the operator performance is evaluated by the master supervisor and he decides if the trainee operator is approved or not.

Experienced operators are evaluated (performance) every two years, in order to evidence if they retained the necessary knowledge to perform their planned tasks.
SUMMARY AUDIT REPORT

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
□ not in compliance with

Production Practice 4.2

Summarize the basis for this Finding/Deficiencies Identified:
All plant/ process operators are trained and qualified to be emergency responders. The emergency responders training takes around 33 hours of training which scope includes: first aid, fire fighting, chemical emergencies, emergency hardware use, drills. This process is performed every year. The performance of the participants is determined through testing (theoretical and practical). Annually they participate in a refreshing training session and participates in emergency drills.
All the emergency drills are reviewed in terms of performance to confirm if the personnel did act adequately and the emergency response plan is correct. Reviewed intoxication drill report, carried out during 2016 where the results were adequately reviewed.
The operation (Human Resources process) retains all training records, which address the trainee name, instructor name, scope of training, date of training, duration of training, and the performance of the trainee.

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
□ not in compliance with

Production Practice 5.1

Summarize the basis for this Finding/Deficiencies Identified:
Proquigel established, implemented and maintained procedures in order to address potential releases of cyanide that may occur on site or may otherwise require response such as:
SEG.P.19 - “Emergency Response Plan for Cyanide Plant”; SEG.P.5 - General Emergency Plan, SEG.P.3 - Emergency During Cyanide Transportation, SEG.P.16 - “Emergency Plan and Crisis Control”; SEG.P.18 - Communication During Emergency; SEG.P.17 - Emergency Response Plan; NS.04 - COFIC Emergency Plan, SEG.NO.36 - Emergency Brigade which include scenarios such as: Catastrophic release of hydrogen cyanide, releases during loading and dissolution operations, releases during fires and explosions, pipe, valve and tank ruptures, power and equipment failures, outages and overtopping of ponds, tanks and waste treatment facilities. They describe specific response actions, as appropriate for the anticipated emergency situations, such as evacuating site personnel and potentially affected communities from the area of exposure, use of cyanide antidotes and first aid measures for cyanide exposure, control of releases at their source and containment, assessment, mitigation and future prevention of releases.

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

The operation is ☒ in full compliance with □ in substantial compliance with □ not in compliance with

Production Practice 5.2

Summarize the basis for this Finding/Deficiencies Identified:

Internal documented procedure SEG.P.19 item 5.1.1 defines methodology that Proquigel uses in order to involve its workforce and stakeholders. Evidenced duly implemented.

Evidenced that the Health, Safety and Environmental Manager Mr. Deiviti Caetano performed a presentation about “Sodium Cyanide Manual” for all Companies of Camaçari Charlie Area.

Evidenced records of training provided by Proquigel for all direct or indirectly persons involved with cyanide like PAM - Mutual Aid Plan, PAME – Medical Emergency Plan, COFIC and COSIMA.

Evidenced that Proquigel has a program named “Ver de Dentro” in order to integrate Proquigel with the communities.

Proquigel has a contract with SOS Cotec for support in occurrence of accidents during cyanide transportation.

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

The operation is ☒ in full compliance with □ in substantial compliance with □ not in compliance with

Production Practice 5.3

Summarize the basis for this Finding/Deficiencies Identified:

Evidenced that Proquigel Emergency Plans designate primary and alternate emergency response coordinator. It is clearly identified the Emergency Response Team and individual responsibilities and authorities. Training requirements are defined. Evidenced that Proquigel Emergency Brigade has been trained in accordance Brazilian legislation laws. During the field audit, evidenced all emergency response equipment were available on-site as stated. Pertinent checklists provided evidence that emergency response equipment has been inspected as stated. Observed a list containing 24-hour contact information for the coordinators and response team members. Role of outside responders, medical facilities and communities in emergency response procedures are clearly describe such as PAM, PAME, COFIC, COSIMA, INEMA, Militar Fire Brigade, Area Charlie Camaçari Brigade, e. Bahia Militar Police, Bahia Civil Police, Simões Filho Civil Police, SOS COTEC, Concordia Transportes, Niquini Transportes, Hospital São Rafael, Organized Civil Society. Evidenced that Proquigel confirmed that outside entities included in the Plan are aware of their involvement and are included as necessary in mock drills or implementation exercises. Records assessed were reviewed and provided evidences of adequate aware of outside entities. Sampled examples were: COSIMA meetings ( PAM - Camaçari Mutual Help Plan and PAME – Emergency Camaçari Help Plan) dated on February 25, 2016; April 28, 2016, June 8, 2016, September 15, 2015, November 17, 2015 and August 10, 2016; Meetings with “Organized Civil Society”; Mock Emergency Drills – Concordia Transportes, Camaçari Police, Bahia Militar Police, Militar Fire Brigade, Simões Filho Fire Brigade, Hospital São Rafael, PAME Hospital, SOS Cotec dated on October 21, 2015.

Records assessed were reviewed and provided evidences of adequate aware of outside entities.

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

- X in full compliance with
- □ in substantial compliance with
- □ not in compliance with

Production Practice 5.4

Summarize the basis for this Finding/Deficiencies Identified:

Internal documented procedure SEG.P.16 item 5 and Annex II clearly identify procedures and contact information for notifying management, regulatory agencies, outside response providers and medical facilities of the emergency, as appropriate as well as clearly identify procedures and contact information for notifying potentially affected communities of the incident and/or response measures and for communication with the media. Evidenced that the above-mentioned procedure is duly established, implemented and maintained.

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

- X in full compliance with
- □ in substantial compliance with
- □ not in compliance with

Production Practice 5.5

Summarize the basis for this Finding/Deficiencies Identified:

Evidenced that internal documented procedures SEG.P.19 – “Emergency Control in Cyanide Plant”, SEG.P.16 and MEA.P.08 clearly describe: a) appropriate remediation measures, such as recovery or neutralization of solutions or solids, decontamination of soils or other contaminated media and management and/or disposal of spill clean-up debris, and provision of an alternate drinking water supply, as appropriate; b) Clearly prohibit the use of chemicals such as sodium hypochlorite, ferrous sulfate and hydrogen peroxide to treat cyanide that has been released into surface water as well as procedures SEG.P.19 – “Emergency Control in Cyanide Plant”, SEG.P.26 and SEG.P.20 item 6.2.31q and item 6.2.12 clearly address the potential need for environmental monitoring to identify the extent and effects of a release, and include sampling methodologies, parameters and, where practical, possible locations Evidenced that the above-mentioned documented procedures are duly established, implemented and maintained.

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

- X in full compliance with
- □ in substantial compliance with
- □ not in compliance with

Production Practice 5.6

Summarize the basis for this Finding/Deficiencies Identified:

Evidenced that internal documented procedure SEG.P.19 Emergency Plan in Cyanide Plant item 5.5 include provisions for reviewing and evaluating its adequacy on an established
frequency. Evidenced that mock emergency drills are conducted periodically as part of the Plan evaluation process. Sampled examples were: Evidenced that mock emergency drills are conducted periodically as part of the Plan evaluation process. Sampled examples were: Records of mock emergency drills dated on October 21, 2015 HCN emission during transportation of cyanide solution (performed with Concordia Transportes); Evidenced mock emergency drill dated on September 29, 2016 related to TQ 220-05B (Cyanide tank). All of these records clearly demonstrate - Objectives of simulations such - Review of Emergency Plans, Review of check emergency Procedures Training of Emergency Response Brigade, Review of stakeholders involvement, Review of Communities Involvement, Measuring of Communication effectiveness, Review of Internal resources, Review of PAME and PAM