SUMMARY AUDIT REPORT

International Cyanide Management Code Recertification Audit

Orica Australia Pty Ltd, Yarwun Production Facility ICMC Recertification Audit

Submitted to:

International Cyanide Management Institute (ICMI)
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UNITED STATES OF AMERICA

Orica Australia Pty Ltd
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APPENDIX A
Important Information

1.0 INTRODUCTION

1.1 Operational Information

Name of Production Facility:	Yarwun Production Facility
Name of Facility Owner:	Orica Australia Pty Ltd
Name of Facility Operator:	Orica Australia Pty Ltd
Name of Responsible Manager:	Rod Waldron, Senior Specialist Safety, Health, Environment and Security (SHES)
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1.2 Description of Operations

1.2.1 Orica Australia Pty Ltd

Orica is an Australian-owned, publicly listed company with global operations, and one of the world's largest producers of cyanide.

1.2.2 Yarwun Production Facility

Orica operates the Yarwun Production Facility, which is located 9 km north-west of Gladstone, QLD. The Site has been operational since 1990 and Orica operates the following plants at the site:

- Three Nitric Acid plants
- Two Ammonium Nitrate plants
- Ammonium Nitrate Emulsion Phase plant
- Sodium Cyanide plant.

The facility also operates two raw material import facilities at the Fisherman's Landing port, located approximately 5 km north of the main site. The facilities incorporate ammonia and caustic soda unloading and storage facilities that are connected to the site through an underground pipe network. The site employs more than 230 permanent personnel along with contractors. At any one time the maximum number of persons likely to be on-site is between 175 and 250 personnel.

Cyanide is manufactured at Yarwun using the Andrussow process. In this process, hydrogen cyanide (HCN) is produced by reacting ammonia, natural gas, and pre-heated process air over a platinum catalyst. The HCN is then absorbed with caustic soda to form a solution of sodium cyanide. This cyanide liquor can then be concentrated, crystallised, dried, and compacted into solid sodium cyanide.

Cyanide manufactured at Yarwun is used in gold mining operations within Australia, Asia, Africa, Papua New Guinea, New Zealand, and South America.

1.3 Auditors' Findings and Attestation

	☒ **in full compliance with**	
Orica's Yarwun Production Facility is:	☐ in substantial compliance with	**The International Cyanide Management Code**
	☐ not in compliance with	

Audit Company: Golder Associates Pty Ltd

Audit Team Leader: Ed Clerk, Lead Auditor and Production Technical Specialist

Email: eclerk@golder.com.au

27 cyanide exposure incidents were noted as occurring during the audit period. These are discussed within Section 2.2 of this Summary Audit Report.

Name and Signatures of Auditors:

Name	Position	Signature	Date
Ed Clerk	Lead Auditor and Production Technical Specialist		11 Sept 2020
Craig Currie	Auditor		11 Sept 2020

Dates of Audit

The field component of the audit was undertaken over 18 to 20 February 2020.

The audit was undertaken by Ed Clerk (ICMI Lead Auditor and Production Technical Specialist) and Craig Currie (Auditor). Ed acted in the capacity of ICMI Lead Auditor and ICMC Production Technical Specialist during the audit.

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 Production Operations and using standard and accepted practices for health, safety, and environmental audits.

Orica Yarwun Production Facility		11 September 2020
Name of Facility	Signature of Lead Auditor	Date

2.0 PRINCIPLES

2.1 Principle 1 – Operations

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

2.1.1 Production Practice 1.1

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

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 1.1**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 1.1 requiring cyanide production facilities to be designed, constructed, and operated to prevent releases of cyanide.

Quality control and quality assurance (QA/QC) programs have been implemented during construction of cyanide production and storage facilities. QA/QC records have been retained. Appropriately qualified personnel reviewed the Yarwun facility construction and provided documentation that the Yarwun facility has been built as proposed and approved.

During the Certification Audit in 2006 it was verified that quality management programs had been implemented during the original construction and subsequent modification of cyanide production and storage facilities, that records had been retained and that the reviews had been undertaken by appropriately qualified personnel.

Since 2018, 152 modifications have been completed on the cyanide plant within the Chemicals Complex.

It is a requirement of the Plant Modifications Procedure that full records of the modification shall be filed in the Plant Dossier as referenced from the relevant Modification File. The procedure also provides for a Completion Check to record and ensure that all aspects of the Modification have been completed from engineering, operational and safety, health and environment perspectives and signed off by qualified Orica personnel.

The Plant Dossier is a formal information system that includes:

- Design specifications for process equipment
- Engineering Line Diagrams
- Hazard Study Records
- Equipment files.

The materials used for construction of cyanide production facilities are compatible with the reagents used and the processes employed.

Standards adopted for materials of construction were set out in the report of the Certification Audit in 2006. Those standards have continued to be employed for the design and installation of new equipment installed. Improvements are ongoing and include:

- Lining of chemical complex trenches with stainless steel
- Improvements to the piping standard to include more detailed information around gasket specifications
- New floor sealing designs
- No use of aluminium, brass, and bronze due to incompatibility with caustic.

The Yarwun General Scheme for Piping and Gasket Specification for the cyanide plant was provided as evidence. This approved specification can be used on all Yarwun piping, for either new projects or in maintenance activities.

There are automatic systems or “interlocks” to shut down production systems and prevent releases due to power outages or equipment failures.

As verified in the Certification Audit, the cyanide plant design is such that there is no risk of a cyanide release in the event of power failure. The cyanide plant fails in a safe state.

Physical process controls are implemented through a programmable Distributed Control System (DCS) and through a hard-wired trip system. In the event that control is lost, a Trip 10 (Total cyanide plant Trip) is activated, which over-rides operation of the front end (conversion and absorption area) of the cyanide plant. This is one of several automatic systems that protect the cyanide plant from an uncontrolled event.

There is an emergency power supply to maintain lighting and critical processes function (critical trips, backup air system, etc) rather than keep the cyanide plant fully functional. A standby power generator feeds an uninterruptible power supply.

Cyanide is managed on a concrete surface that can minimise seepage to the subsurface.

As verified in the Certification Audit, there is extensive concrete surfacing in the process area, which is bounded by a stainless steel lined perimeter drain discharging to the Effluent Sump that is lined with concrete and a chemical resistant membrane. The Cyanide Tank Farm Bund is also lined with concrete and a chemical resistant membrane. All tanks containing cyanide process solutions, except for the inground solids dissolving tank, are supported at grade level are founded on concrete plinths.

Solids Dissolving Tank is located below ground floor level to facilitate gravity drainage from equipment on the ground floor of the Cyanide Plant. The tank is of a dual skin design with 3 x 50nb nozzles giving access to the annular space between the 2 tank walls. Nozzle 'R' is for a level probe LT-0435, nozzle 'S' is to enable a pump to be used to empty the space if required, and nozzle 'T' is for a visual inspection point.

Since 2018:

- Electrostatic earth points in the concrete have been sealed
- Protective coating has been applied to the floor
- Trenches have been lined with stainless steel.

The facility employs methods to prevent the overfilling of cyanide process and storage vessels.

As verified in the Certification Audit, there are extensive level instruments and trip systems throughout the facility. Physical process controls are implemented through a programmable DCS and through a hard-wired trip system. Trip 10 (Total cyanide plant Trip) is the key trip that is activated in the event of potential loss of control as may be indicated through high-high level alarms. Operator inspections are used to verify levels reported to the DCS via instrumentation are correct. Levels are recorded in check sheets. There are preventative maintenance systems in place for sensors including level sensors.

Secondary containments are provided for process and storage tanks and containers are constructed of materials that provide a competent barrier to leakage, and are sized to hold a volume greater than that of the largest tank or container within the containment and any piping draining back to the tank, with additional capacity for the design storm event.

As noted in the Certification Audit, there are two secondary containments for process and storage tanks and containers. These are the Cyanide Storage Tank Bund and the Effluent Pit. There have been no changes to the secondary containment volumes during the audit period and the laser scanning program confirmed bund containments met Australian Standards, licence conditions and Code requirements.

Spill containment and prevention measures are provided for all cyanide solution pipelines.

As noted in the Certification Audit, flange guards are used on cyanide solution pipe flanges on above ground pipelines. Pipe in pipe solution lines between the absorber catch pots and the solids dissolving tank have level transmitters and inspection ports.

The operation has two underground drains that intermittently carry cyanide solution intercepted by stainless steel line perimeter trenches downgradient of the main processing area. These drains convey solutions to the Effluent Pit and are configured to enable a regular leak test to be conducted as a prevention measure.

2.1.2 Production Practice 1.2

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

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 1.2**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 1.2 requiring the development and implementation of plans and procedures to operate cyanide production facilities in a manner that prevents accidental releases.

The Yarwun facility has procedures that describe the standard practices necessary for its safe and environmentally sound operation.

The plans and procedures adopted at the Yarwun facility are based upon the Orica Safety Health and Environment Management System. Plans and procedures are administered through both the Orica Yarwun Site Document Management System (DMS) (based on Lotus Notes) and SAP (Business Management Software System).

Information on the computerised systems is made available to plant personnel via Orica's computer network and all personnel have access. Plant personnel who are not allocated an individual computer and network connection have access to the documentation through shared equipment located in:

- CN complex control room (seven terminals)
- Facilitator's office
- Conference room.

Since 2018, the operation has updated routine tasks and critical infrequent tasks documented in the DMS to improve or eliminate risks. Examples include improvements to the stormwater system and centrifuge washouts. The plant start-up (conversion start-up) represents the highest risk to the safe and environmentally sound operation of the facility and a start-up is initiated two to three times each year. At the time of the audit the procedure was in the process of being significantly revised following an 18-month review.

The Yarwun facility has procedures for contingencies during upsets in its activities that may result in cyanide exposures or releases.

The menu screen of the site's DMS displays the systematic structure of the documentation which includes Abnormal Operating Instructions for each process node. Each processing node procedure (Conversion, back end centrifuge) follows a set structure:

- Abnormal operations
- Forms
- General process description
- Job procedure
- Main items and key facts
- Normal operations
- Safety
- Shut down
- Start up.

The standard features of Abnormal Operating Instructions address the following generic abnormal conditions:

- Power Failure
- Instrument Air Failure.

Other abnormal conditions are specific to the kinds of processing upsets and incidental conditions that may arise predictably but irregularly during operations, such as machine failures (agitators, pumps), material accumulations and blockages.

The Yarwun facility uses Uniformance to monitor trends in abnormal operating conditions from the administration office and areas of the control room usually occupied by the Plant Superintendent and Shift Facilitator. This enables analytical and interpretive input to be made by specialised staff, without needing to interfere with the "live" activities of the plant technician dealing with abnormal conditions.

The Yarwun facility has a procedure to identify when site operating practices have, or will be, changed from those on which the initial design and operating practices were predicated.

Since 2018, 152 modifications have been completed on the cyanide plant within the Chemicals Complex. These modifications were implemented in accordance with the Plant Modifications Procedure.

The procedure applies to all plant modifications to ensure that they are implemented in a manner which does not present a hazard to safety, health, the environment, or physical security.

The operation uses SAP for its asset management functions. ENABLON administers the proposal and approval of plant changes and these then follow through to asset maintenance in SAP. The SAP system prevents the issue of work orders relating to proposals that have not been approved. At the time of the audit, the operation was commencing a transition from SAP to ENABLON. Modification proposals are reviewed by suitably qualified people including appropriate line managers and workgroup Safety, Health & Environment (SH&E) representatives to ensure appropriate hazard management, application of design standards, regulatory compliance, and the use of risk assessment approaches.

Under the Yarwun facility's organisation structure, it is the accountability of the Product Line Technical Manager to ensure it is consistent with the site's SH&E objectives and targets and to assess its potential to introduce new significant hazards, substantially increase site risk or otherwise change the basis on which the site is expected to operate. The sample of modifications observed showed that the Yarwun facility SH&E Manager had reviewed and signed off on the proposed changes in all cases sampled.

Facilitated by capabilities of Lotus Notes, the DMS incorporates a revision control process which enables Yarwun facility personnel to participate in the regular review of procedures, recommending improvements by annotating a copy of the controlled procedure with suggested changes.

Preventive maintenance programs are implemented, and activities documented, for equipment and devices necessary for cyanide production and handling.

The operation uses SAP for its asset management functions. Preventive maintenance has been the focus of continual improvement. The approach adopted focuses on processing systems, based on the commonality of processing conditions (composition, temperature and pressure, etc), materials of construction and engineering standards that are adopted for groups of equipment that comprise larger systems at various steps through the material flow sequence of the manufacturing process.

Preventive maintenance is scheduled and carried out for equipment items including pressure vessels, tanks, pumps, piping, valves, bunds, and drains, with the nature of the activities specific to the operating conditions rather than just the type of equipment. Maintenance is assigned an activity type and criticality indicator. Activity types include:

- Statutory
- Pump
- Vibration
- Ultrasonic

- Improvement
- Process cleaning.

Criticality indicators include:

- A – SHEQA and Business critical
- B – SHEQA critical
- C – Business critical
- D – Not business critical.

The risk of cyanide releases and exposures from the “front end” of the cyanide plant is low because the reaction to produce hydrogen cyanide is carried out in the gas phase and there is very little storage of cyanide in the plant. The chemical reaction catalyst gauze used to convert ammonia and methane to hydrogen cyanide needs to be changed at intervals of six to nine months. Between catalyst gauze changes, the operation seeks to operate continuously to maximise operating efficiency and to avoid the processing variations that can increase the likelihood of incidents. The process air compressor is a critical equipment item required for reliable operation. To support its reliable operation, it is subject to monitoring including bearing and vibration analysis to gather data supporting the planning of preventive actions to be taken during gauze changes, to maximise the likelihood of trouble-free operation during the next operating campaign.

Slurries are handled as solutions, whilst solids are in dry form, in separate process streams comprising the two “back ends” of the cyanide plant. The back end is inherently less reliable than the front end, requiring more maintenance and repair. The back end is inherently less reliable than the front end, requiring more maintenance and repair. Management schedules the operation of the two back end streams in campaigns based on staggered 3 (minor) and 6 (major) week operating cycles, so that each stream has one week in three when its maintenance requirements become a focus. During each stream’s maintenance week, it shuts down for four to 14 hours depending on the equipment to be isolated to enable activities to be carried out that are not possible whilst the plant is running.

The preventive maintenance administration functions are managed through SAP, which supports a total maintenance system that integrates administration of the:

- Equipment Register
- Spare Parts
- Preventive Maintenance Routines
- Work Orders for Maintenance, Repair and Modification
- Maintenance and Repair History of equipment items.

Process parameters are monitored with necessary instrumentation. The instrumentation is calibrated according to manufacturer’s recommendations.

The cyanide plant is extensively instrumented. Some instruments display locally to the process equipment monitored whilst others indicate status in the control room, either via the DCS displays or on hard-wired indicators.

Examples of key instrumentation used to control the chemical quality of product supplied from the Yarwun facility, waste streams disposed from it and the environmental quality at the facility include:

- Pyrometers used for temperature control of the HCN Converter.
- Pressure transmitter installed on the HCN Converter to confirm normal operation (55-80 kPa) and to raise alarms (120 kPa and 130 kPa) to indicate increased risk of a release (bursting disc rupture at 200 kPa).
- Redox potential probe used to control the addition of sodium hypochlorite to destroy cyanide in wastewater.
- HCN detectors installed to monitor for hydrogen cyanide concentrations in the workplace.
- Level transmitter in the Stormwater Pit.

The pyrometers and HCN detectors are scheduled in SAP for preventive maintenance routine. The pyrometers can only be accessed during plant shutdowns. Hence, the temperature of the catalyst gauze in the converter is cross-checked against measurements collected manually using a spectrometer. The temperatures indicated by the installed pair of pyrometers are compared against each other automatically to provide a continual cross check of their respective calibrations.

The manufacturer's recommended procedure for calibration of the HCN Gas Detectors is adopted at the Yarwun facility and implemented regularly.

The redox potential probes installed on the Cyanide Effluent Tank are calibrated using a work method that incorporates the manufacturer's calibration specification.

The Yarwun facility has an environmentally sound procedure to prevent unauthorised/unregulated discharge to the environment of any cyanide solution or cyanide-contaminated water that is collected in a secondary containment area.

Plant systems for managing effluent and potentially contaminated stormwater are configured separately. The Environmental Authority issued by the regulator dictates the release limits. Compliance with requirements for actual effluent releases are maintained through an effluent treatment batching process supplemented by hard controls in the DCS.

Stormwater is retained separately, checked for compliance, and then pumped to the discharge point.

The Yarwun facility has an environmentally sound procedure for disposal of cyanide or cyanide-contaminated solids.

The Yarwun facility no longer accepts the return of customers used packaging materials. Procedures remain in place for the disposal of onsite generated waste material. The procedure of the despatch of regulated waste identifies cyanide contaminated wastes such as oils, greases, bags, and liners as requiring disposal in accordance with applicable regulation. The Environment Team is responsible for ensuring that wastes are correctly classified so that arrangements can be made for the waste to be disposed of to an appropriately licensed facility. The movements of such wastes are required to be tracked using Waste Transport Certificates as a means of verifying that movements only occur between appropriate locations and under the control of licensed transporters.

Most of the waste products leaving the plant are rinsed with hot condensate, tested for cyanide levels, and confirmed for disposal offsite. Items that are not handled this way, i.e. liners from the bag to bulk process, are not rinsed but are still disposed of via regulated waste transporters and authorised waste destruction facilities.

Wherever possible, cyanide-contaminated equipment or materials are decontaminated rather than disposed of as cyanide-contaminated solids. For example, equipment sent off-site for maintenance inspections is decontaminated before departure. The decontamination approach is preferred to disposal as it is environmentally sound and reduces the cyanide-related risks.

Cyanide is stored:

- With adequate ventilation to prevent the build-up of hydrogen cyanide gas
- With measures to avoid or minimise the potential for exposure of cyanide to moisture
- In a secure area where public access is prohibited.

Cyanide is stored in a designated building. The building is a steel-clad structure with whirl roof vents, wall louvres and significant openings in its sides for ventilation. Storage is within timber boxes that have a double lining system. Also, within the warehouse there is a system for loading sparge isocontainers; the procedures for loading the sparge isocontainers provide for the isocontainer to be sealed to prevent the ingress of water. The site has stringent formal security arrangements with different requirements applicable to defined areas. Orica's Yarwun facility is designed as a Security Sensitive Ammonium Nitrate (SSAN) site under Commonwealth regulations. The highly integrated security features include employee checks, access control and a high standard of perimeter fencing.

There are procedures to ensure that the cyanide is packaged as required by the political jurisdictions through which loads will pass.

Product supplied from the Yarwun facility is packaged in three forms:

- Cyanide solution in liquid isocontainers built and designed in accordance with the Australian Dangerous Goods (ADG) Code.
- Cyanide solids in ADG-approved sparge isocontainers.
- Cyanide solids in UN-approved standard wood/plastic composite intermediate bulk containers (IBCs) comprising bulk bags inside a liner within a timber box. The IBC design is tested by a NATA-accredited laboratory to the relevant requirements of the Orange Book, the Australian Dangerous Goods Code, and the Code. Boxes are branded with the UN approval number UN/11HD2/X/0506/AUS/Orica-42119/6480/1200. Boxes are transported in shipping containers that must carry a current compliance plate to satisfy the requirements of the International Maritime Organization (IMO). The operation has to deal with special requirements of one country, Peru, where there are special requirements regulating the space required between packages and the door of the shipping container.

Product packages carry labels in accordance with UN regulations, identifying the UN number of the product, the product class and detailing safety precautions. Product packages destined for use within Australia must carry an Emergency Information Panel (EIP) in accordance with criteria set out in the Australian Dangerous Goods Code. The operation voluntarily displays an EIP on packages destined for export. The procedure prescribes the correct locations for each EIPs, marine pollutant stickers and poison stickers. The EIP identifies Orica as the consignor and provides contact details for emergency response assistance; Orica Australia operates a 24-hour emergency response service to provide emergency response information.

2.1.3 Production Practice 1.3

Inspect cyanide production facilities to ensure their integrity and prevent accidental releases.

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 1.3**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 1.3 requiring the inspection of cyanide production facilities to ensure their integrity and prevent accidental releases.

The Yarwun facility conducts routine inspections of pressure vessels, tanks, valves, pipelines, containments and other cyanide production and storage facilities as noted in this question.

The operation uses SAP for its asset management functions. Preventive maintenance has been the focus of continual improvement. Preventive maintenance is scheduled and carried out for equipment items including pressure vessels, tanks, pumps, piping, valves, bunds, and drains, with the nature of the activities specific to the operating conditions rather than just the type of equipment. Maintenance is assigned an activity type and criticality indicator. Activity types include:

- Statutory
- Pump
- Vibration
- Ultrasonic
- Improvement
- Process cleaning.

Criticality indicators include:

- A – SHEQA and Business critical
- B – SHEQA critical
- C – Business critical
- D – Not business critical.

The preventive maintenance administration functions are managed through SAP which supports a total maintenance system that integrates administration of the:

- Equipment Register
- Spare Parts
- Preventive Maintenance Routines
- Work Orders for Maintenance, Repair and Modification
- Maintenance and Repair History of equipment items.

The procedure for in-service inspection of pressure vessels applies to the routine inspection and integrity testing of pressure vessels, many of which are in cyanide service. The vessels are on inspection periods of up to four years based on failure modes and history.

Underground lines handling cyanide solutions are subject to hydrostatic testing every five years with the effluent lines inspected every two years.

Atmospheric pressure tanks in cyanide solution duty are scheduled for integrity inspections every five years.

Bunds providing secondary containment to cyanide solution storage tanks are scheduled for annual integrity inspections.

Pipelines handling cyanide solutions sometimes include flexible hoses to isolate the piping from the vibration associated with machines such as centrifuges. These hoses are identified as critical items of equipment and are scheduled for six-monthly hydrostatic testing.

Pumps in cyanide solution services are scheduled for inspection of seals and overall integrity, typically on six monthly cycles.

Operational inspections occur more frequently than integrity inspections. Operators conduct per-shift (i.e. twice daily) inspections in their areas of responsibility. These inspections focus more on short term issues such as the detection of leaks, housekeeping (available space in bunds free of hoses, containers, loose equipment, etc), the correct configuration of equipment (such as flange guards and safety signs) and signs of operating conditions (such as vibration, noise or heat) that may indicate a risk of early integrity failures. Weekly inspections address similar issues to the daily inspections, but allow for more time to be allocated as a cross check to the effectiveness of the shift inspections.

Inspection frequencies are sufficient to assure that equipment is functioning within design parameters.

Process operation is monitored continually using permanently installed process instrumentation for levels, flows, temperatures, pressures, and composition-related parameters. Most parameters are displayed in the control room via the DCS or hard-wired instruments. The DCS provides the means of automatic control as well as manual manipulation of the status of equipment, with alarms set to flag when equipment moves outside normal control ranges or when equipment changes operating status. Trips are also installed to automatically shut down process operations safely under pre-determined scenarios that pose unacceptable risk.

As described above, there are an extensive range of inspections carried out ranging from twice daily (one per-shift) through weekly to annually and less frequent for integrity inspections.

Whilst there have been incidents involving the leaks of cyanide solutions where equipment has become degraded, none of these incidents has resulted in significant consequences (apart from a leak identified many years ago from a below-ground tank; the risk of recurrence has been significantly reduced).

Inspection of the process plant during the audit indicated a very high standard of housekeeping. There was evidence that some minor releases had occurred in the 24 hours period prior to the inspection – these being related to routine operations around the centrifuges.

Based on the reported frequency and severity of cyanide incidents, the observation of a high standard of control over leaks and the existence of an ongoing program of continual improvement to eliminate sources of leaks and spills, it is concluded that inspection frequencies are sufficient to assure that equipment is functioning within design parameters.

Orica Yarwun Production Facility		11 September 2020
Name of Facility	Signature of Lead Auditor	Date

Inspections are documented:

- The documentation identifies specific items to be observed and includes the date of the inspection, the name of the inspector, and observed deficiencies.
- The nature and date of corrective actions are documented and the inspection records are retained.

Records of inspections of major equipment items with regulatory implications are maintained in SAP along with the procedure for the equipment inspection, hours booked against the equipment number, whether the inspection was completed, name of the inspector and the date. Some statutory inspections are physically signed and scanned into SAP.

The daily and weekly checklists completed by operations personnel are stored as bound hardcopies in the control room area for approximately two years before they are transferred to archive. The check sheets are completed with the name of the person undertaking the inspection together with the date (and shift where applicable).

Actions identified as necessary during inspections may be initiated as new work orders in SAP or their completion may be recorded on the inspection sheets if they are capable of immediate resolution.

2.2 Principle 2 – Worker Safety

Protect workers' health and safety from exposure to cyanide

2.2.1 Production Practice 2.1

Develop and implement procedures to protect plant personnel from exposure to cyanide.

	☒ **in full compliance with**	
The Transfer Facility is	☐ in substantial compliance with	**Production Practice 2.1**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 2.1 requiring the Facility to develop and implement procedures to protect plant personnel from exposure to cyanide.

The Yarwun facility has developed formal procedures to minimise worker exposure during:

- normal plant operations from receipt of raw materials through finished product packaging and shipping
- non-routine and emergency operations
- maintenance related activities.

All documents prepared for the Yarwun facility are managed within the Yarwun DMS. The Preparation and Implementation of Yarwun System Documents procedure provides detailed instructions regarding the preparation of Yarwun facility system documents (procedures, instruction, and forms). The procedure notes that all procedures shall be developed using the following format:

- Purpose
- Scope
- Applicable documents
- Definitions
- General Requirements
- Safety requirements
- Detailed Requirements

Detailed procedures have been prepared covering the discrete components of the cyanide plant:

For each discrete component listed above procedures have been developed covering the following topics:

- Abnormal Operating Instructions
- General process description
- Forms
- Job Procedures
- Main Items and Key Facts

- Normal Operation
- Safety
- Shutdown
- Start-up.

Within the Safety Procedures for each component of the Cyanide plant, the issues of toxicology, PPE, housekeeping, and other special information (such as exothermic hydrolysis reactions within the evaporative process) are discussed in detail.

Operating procedures and instructions were reviewed and it was noted that the appropriate level of safety detail was contained within the documents. It was noted that in addition to safe practices being described within the section relating to Safety, they were also integrated within the procedures for Normal Operations, Shut Down and Abnormal Operations.

In addition to area specific safety procedures, the Yarwun facility has developed specific safety system procedures detailing the safety systems relevant to the cyanide plant including:

- Safety system tests
- Safe working procedures
- Cyanide safety
- Isolations and permits
- Visitors in the cyanide plant
- Preparation of equipment for maintenance.

For routine maintenance activities conducted outside of shutdown operations, safety instructions are detailed on Job Instructions linked to preventative maintenance schedules. JSERA (job safety environment risk assessment) are undertaken for specific jobs on a case by case basis.

It was considered that the procedures and work instructions maintained on the DMS, along with safety information detailed on maintenance requests as part of the preventative maintenance system, adequately satisfy the requirements of this question.

The Yarwun facility has implemented procedures to review proposed process and operational changes and modifications for their potential impacts on worker health and safety, and incorporate the necessary worker protection measures.

The Plant Modifications Procedure applies to all plant modifications to ensure that they are implemented in a manner which does not present a hazard to safety, health, the environment, or physical security.

Modification proposals are reviewed by suitably qualified people including appropriate line managers and workgroup SH&E representatives to ensure appropriate hazard management, application of design standards, regulatory compliance, and the use of risk assessment approaches.

Under the Yarwun facility organisation structure, it is the accountability of the Technical Manager to ensure it is consistent with the site's SH&E objectives and targets and to assess its potential to introduce new significant hazards, substantially increase site risk or otherwise change the basis on which the site is expected to operate. This accountability is consistent with an approach to managing cyanide risks by adopting technical options with inherently low risk. The sample of modifications observed showed that the Site SH&E Manager had reviewed and signed off on the proposed changes in all cases sampled.

The Facility does solicit and consider worker input in developing and evaluating health and safety procedures. The operation solicits worker input in developing and evaluating health and safety procedures at the Yarwun facility using five key processes:

- Standard Operating Procedure amendments within the DMS with automated updates sent to the workforce
- Standard Operating Procedure Review Process
- During Shift Handovers – Chemicals Plant Operations Log
- Personnel meetings
- Critical Issues Meeting/Prestart Meetings/Toolbox Discussions
- Formal SH&E committee meetings (for major site-specific subject matter).

The DMS stores and provides widespread access to the latest approved copy of Yarwun facility system documentation. It is available on-line and site wide. All employees have the capability to review and propose an update to any document administered within the DMS. Where a change is proposed, the document is locked out and all text is changed to blue. The changes proposed by employees appear in red which allows easy recognition of proposed changes by the document owner when considering proposals. All proposed changes are forwarded to the Cyanide Document Delegate (Plant Operator Level). Minor changes that do not alter the intent of the document can be approved by the Cyanide Document Delegate. Other changes are required to be approved by the cyanide plant Document Authoriser. The current cyanide plant Document Authorisers range in plant operational experience from 16 to 26 years in the cyanide manufacturing industry. In the case of Plant Operators and other groups who use a shared electronic mail address, the Shift Facilitator solicits views of all team members.

A review period is assigned to all procedures and is based on the criticality of the procedure. The document owner who is assigned at the development of the procedure is responsible for conducting the review. The review process is the same as that described for procedure amendments.

A Chemical Complex Operations Log (CCOL) is completed at each shift change and is a record of communications from each shift. Communications can include proposed changes to operational procedures as well as safety information. In addition to completing the CCOL, the Facilitator, Cyanide Liquor Technician, Solids Technician (No 1 backend), Solids Technician (No 2 backend) and DCS Operator all hand over verbally to their counterparts on the new shift prior to leaving. Issues concerning the need for procedural change and safety concerns are discussed during this time.

A Critical Issues Meeting involving maintenance, process engineering, the Chemicals Complex Superintendent and Shift Facilitator commenced in August 2008 and is held routinely on a weekly basis. The meeting is used to discuss critical issues including safety issues that require priority actions. The forum can be used to discuss critical procedure reviews and solicit input.

A SH&E Bimonthly Meeting is conducted for the Yarwun facility. Issues raised within the meetings are captured within the Safety Health Environment Risk Management Information System (SHERMIS) and tracked to completion. The forum can be used to discuss procedure reviews and solicit input. The operation also utilises the ENABLON system, which will eventually take over the Lotus based SHERMIS.

The facility uses monitoring devices to confirm that controls are adequate to limit worker exposure to hydrogen cyanide gas and sodium, calcium, or potassium cyanide dust to 4.7 ppm (5 mg/m^3) or less, as cyanide.

There are 18 HCN detectors, installed in the following locations:

- Top of Bulk Solids Chute (West End)
- Bag Loading Station
- Inspection Station (Mezzanine Floor)
- Box Filling Booth (four in total)
- Wet Cake Converter area (two in total)
- Mezzanine Floor under Decanter 'C'
- Top of Solids Dissolving Tank
- Cyanide Recovery – Ground Floor
- Cyanide Recovery – Top Floor
- Cyanide Operations Building
- Laboratory Annex Building – East Wall
- Laboratory Annex Building – West Wall
- Change Room – Orica Personnel
- Change Room – Contractors.

Fixed monitors are located in areas with the greatest potential for HCN exposure. The fixed HCN gas detectors have been set to alarm at two levels – 4.7 ppm and 10 ppm. When 4.7 ppm is reached, the detector alarms locally and in the control room to prompt investigation. The HCN alarm located in the Operations Centre air conditioning duct will automatically sound the alarm if gas is detected at or above the alarm settings. In areas where background noise may be an issue such as in the Box Filling Area, fixed detectors also provide a visual alarm. In these areas, a yellow light indicates 5 ppm and a red light indicates 10 ppm. If the red-light flashes, the area is required to be evacuated. The location and number of detectors revealed no obvious anomalies. The detectors were observed during the audit and the DCS Operator within the Control Room showed the HCN alarm signals.

Personnel HCN Monitors are used at the facility and these are managed by the Laboratory Department to monitor worker exposures to HCN during the cyanide plant operation. The selection of employees is undertaken by the Laboratory Analyst and is based on past recordings and exposure risk. The results are used to guide PPE requirements and amend the monitoring program.

The results are entered into the site's occupational hygiene database. Any result exceeding the 4.7 ppm limit (average over eight hours) and 10 ppm limit (over 10 seconds) are highlighted by the database software and an ENABLON Event Report is automatically generated for investigation and reporting.

For the audit period, records indicated that no worker exceeded the 4.7 ppm over eight hours limit and four workers exceeded the 10-ppm instantaneous limit.

The HCN monitoring equipment is maintained, tested and calibrated as directed by the manufacturer.

A procedure has been established whereby the Laboratory Department sends the portable instruments for calibration via the manufacturer (or supplier). Calibration information is summarised on a spreadsheet which is checked on a weekly basis to ensure equipment scheduled for calibration and maintenance is taken out of service and sent off-site on a routine basis. The information contained in the spreadsheet was cross checked against a selection and calibration records over the past three years.

The Fixed HCN Monitors are calibrated by the site Electrical and Instrument Department as part of a preventative maintenance routine every 90 days.

The facility has identified areas and activities where workers may be exposed to HCN gas or cyanide dust and requires the use of PPE as necessary in these areas when these activities are being performed.

For all cyanide plant upgrades or modifications, an occupational health statement is prepared as part of a Hazard Study. The Senior Specialist SHES- Safety advised that no additional areas requiring monitoring were identified during the audit period.

The Yarwun facility has provisions to ensure that a buddy system is used, or workers can otherwise notify or communicate with other personnel for assistance, help or aid where deemed necessary.

The Senior Specialist SHES- Safety and the Process Operators advised that the cyanide plant uses both a buddy and radio system to maintain communication channels. This was confirmed during the site tour. The Site has 21 radio channels with one dedicated to the Chemical Complex. The radio system forms the critical link between an Operator and the DCS Controller within the Control Room. Time spent within the cyanide plant is kept to a minimum and Process Operators only enter to perform specific tasks such as sample collections or to perform maintenance activities such as plant washouts, as required. Where an operator is required to enter the cyanide plant for routine functions, communication is maintained via radio link to the DCS Controller. A Clearance to Work system is in operation for non-routine activities including maintenance activities. This involves conducting a process risk assessment, in addition to the mandatory safe work method statement (SWMS). The Clearance to Work is handed to personnel conducting non-routine activities and then handed back at the completion of the task. During high risk non-routine activities such as a washout, a buddy system operates with a minimum of two persons. In this situation, a second person wearing PPE must stand by to observe the operator. The duty of the observer is to raise the alarm, via radio, in the event of an emergency. A buddy system is also used for emergency response requirements.

When Managers and Supervisors need to enter the cyanide plant, they are required to use the tag board (as all operators do) and inform the Chemicals Complex Shift Facilitator.

A public announcement system is also used at the Yarwun facility.

The facility assesses the health of employees to determine their fitness to perform their specified tasks.

The Yarwun facility has a Health Assessment Procedure that defines the requirements for assessment and ongoing monitoring of employee and contractor health. The procedure contains a number of Appendices and Attachments that detail the following health assessments:

- Orica pre-placement health assessment standard
- Orica job transfer health assessment standard
- Health assessment standard – fitness for work during employment
- Specific fitness for work health assessments
- Biological and health effects monitoring
- Contractors health assessments
- Assessment of health
- Health assessment task matrix
- Employee pre-placement health assessment (operations/manufacturing)
- Employee pre-placement health assessment (office workers)
- Contractors pre-placement health assessment
- Health assessment and monitoring.

A Health Assessment Matrix was reviewed but individual records were not due to confidentiality. Health assessments are undertaken for a variety of reasons, including:

- Pre-placement Health Assessments on all prospective employees prior to an offer of employment.
- Contractor Health Assessments depending on risks associated with the contract work and length of the contract.
- Job Transfer Health Assessments on all job transfers involving a transfer to a significantly different position, significant changes to a person's existing position or where health issues may significantly affect a person's ability to perform work safely.
- Return to Work Health Assessments on persons returning to work after an absence of five working days or more due to illness or injury.
- Periodic Health Assessments (annual) to assess a person's continuing fitness to perform a specific job or monitor a person's exposure to specific chemicals or physical agents.
- Health Assessments by Requests where there are reasonable grounds to suspect the presence of a condition which may be aggravated by work or may compromise the safety of employees or other persons on the site.

The cyanide plant has a clothing change procedure for employees, contractors, and visitors to areas with the potential for cyanide contamination of clothing.

The cyanide plant is demarcated by a blue line. All personnel crossing the blue line to enter the cyanide plant must use the designated change room to change into blue overalls (buttoned at the wrist and neck) which are placed over their existing layer of clothing, black work boots, safety glasses, safety helmet and hearing protection. Gloves are also required for persons undertaking manual work within the cyanide plant.

Upon leaving the facility the blue overalls are removed within the change room and placed in a dissolvable red bag that is collected by an approved external laundry. Remaining PPE items are kept within the Blue Zone and may only be removed from this area by following site decontamination and testing procedures. The use of a dissolvable red bag avoids the requirement for the laundry to directly handle the clothes. Actual contaminated clothing is decontaminated and disposed of on-site. A change room exists for employees, contractors, and visitors.

The change of clothing procedure is also detailed within the induction training material. Observations during the audit confirmed that personnel conformed to these requirements.

Warning signs advising workers that cyanide is present and that, if necessary, suitable PPE must be worn, are located around the site.

As noted above, the cyanide plant is demarcated by a blue line. All personnel crossing the blue line to enter the cyanide plant must use the designated change room to change into blue overalls (buttoned at the wrist and neck) which are placed over their existing layer of clothing, black work boots, safety glasses, safety helmet and hearing protection. Gloves are also required for persons undertaking work within the cyanide plant. This requirement is detailed within a procedure and reinforced during training.

Personnel interviewed had an appropriate level of knowledge regarding PPE requirements and persons working in the cyanide plant were observed wearing the correct PPE.

Personnel are prohibited from smoking, eating, and drinking, and having open flames in areas where there is the potential for cyanide contamination.

The prohibition of all personnel from smoking, eating, and drinking, and having open flames in areas where there is the potential for cyanide contamination is adequately outlined by signage, within site induction programs and procedures. The Safety Systems – NaCN Plant, Normal Operating Instructions procedure details that food and drink may only be consumed at the cyanide plant in the Planning and Superintendent Offices, Operations Centre Mess Room and SH&E hut – all of which are demarcated as a “No Blue Zone”. Food and drink is prohibited in all other cyanide plant areas.

The site induction material clearly describes the cyanide plant as a “nil by mouth area” where eating, drinking, and smoking are prohibited. Smoking is not permitted within the fenced perimeter of the entire site. The induction also details the prohibition of naked flames within the plant.

Observations during the audit confirmed that personnel conformed to these requirements.

2.2.2 Production Practice 2.2

Develop and implement plans and procedures for rapid and effective response to cyanide exposure.

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 2.2**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 2.2 requiring the development and implementation of plans and procedures for rapid and effective response to cyanide exposure.

The Facility has developed specific written emergency response plans and procedures for responding to cyanide exposures. The following list of documents were reviewed:

- Yarwun Operations Emergency Plan
- Orica Mining Chemicals Emergency Response Guide – Sodium Cyanide
- Orica Group Procedure – SHES Emergency Management
- Guidelines for Recognition and Medical Treatment of Cyanide Poisoning.

The Yarwun Operations Emergency Plan (OEP) covers those actions to be carried out by site personnel during an on-site emergency. The OEP addresses the following key items:

- Identify potential emergency scenarios and define combat strategies that control or limit any effect that an emergency or potential emergency may have on personnel, the site/business, the facilities, and neighbouring areas
- Provide the roles and responsibilities of the different response teams
- Describe the response requirements when an emergency alarm sounds
- Facilitate the reorganisation and reconstruction activities so that normal operations can be resumed
- Provide a reference for training so that a high level of preparedness can be continually maintained.

The OEP is supported by the Orica Mining Chemicals Emergency Response Guide – Sodium Cyanide (ERG). The Cyanide ERG has been developed by Orica Mining Chemicals to provide guidance in the development of specific site and transport route emergency response plans for the management of incidents involving spillage of cyanide product; Appendix 4 of the ERG covers toxicity, first aid and medical treatment associated with cyanide exposure.

The Guidelines for Recognition and Medical Treatment of Cyanide Poisoning provides information on exposure pathways, toxic effects and what initial actions personnel should take. It also contains a stepped-out process for responding to an exposure scenario and includes reference to raising an alarm, decontaminating via emergency showers and the use of cyanide poisoning antidotes by medical professionals.

Showers, low-pressure eye wash stations and non-acidic fire extinguishers are located at strategic locations throughout the Facility. They are maintained and inspected on a regular basis.

There are 26 emergency shower/eye wash stations within the cyanide production plant, these consist of the following four types:

- Walk-In Multiple Spray: multiple spray showers provide complete simultaneous coverage of the entire body from all angles by individual spray heads. The shower is activated by stepping on the platform.
- Deluge Shower/Eye Wash: the deluge shower provides a deluge of water when the operating handle is pulled. It is equipped with an eye wash facility, operated by a push handle or foot pedal.
- Eye Wash Units: the eye wash units provide a stream of water to the eyes when the hand operated push handle or foot pedal is activated. These units are pedestal mounted.
- Eye Wash Bottles: portable eye wash; bottles are stationed at each walk-through multiple spray shower station.

The Safety Systems, Normal Operating Instruction lists the location of all shower stations and details the inspection type and frequency required; safety showers and eye wash stations are stated to be tested on a weekly basis. A selection of these were verified during the inspection and site walkover. Plant personnel advised that the equipment had been placed in all areas where there was an increased risk of cyanide exposure and this was supported by observations of the facilities during the site inspection.

Dry powder fire extinguishers were observed throughout the facility and are inspected on a regular basis. Inspection test tags on the equipment were observed to be completed and in date. Fire detectors and 14 push-button stations are provided throughout the site to raise a fire alarm.

The Facility has oxygen, defibrillators, resuscitators, cyanide poisoning antidotes, a site medical transport vehicle and a means of communication or emergency notification readily available for use in the plant.

The site Nurse advised that there are three cylinders of oxygen (Oxysox) and three manual resuscitators located in the cyanide plant. emergency medical kits are located in all toxic refuges, large field kits are located in both control rooms (Chemicals Complex and Ammonium Nitrate Complex) and the Occupational Health Centre and these are used for transport to hospital. Cyanokit Antidotes containing hydroxocobalamin are kept in the fridge within the Occupational Health Centre. Sealed bottled water is readily available in the Occupational Health Centre and also stored at eyewash stations to aid in the rinsing of eyes or the mouth if cyanide has been ingested. Radios are used for communication during an emergency on-site and the telephone is used to advise external parties such as the hospital. The emergency response equipment maintained on site includes the oxygen cylinders, oxygen cylinder trolley, resuscitators, and medical transport vehicle. Antidote injection medicine (sodium nitrate, sodium thiosulfate, and methylene blue) are stored in the on-site Medical Centre. Mobile phones, walkie-talkies and fixed calling points are readily available as a means of communication in the event of emergency. Self-contained breathing apparatus (SCBA) kits are located outside the control room.

Personnel interviewed knew the location of antidotes, response equipment and the emergency notification process. Inspection records were sampled for the audit period and found to be in order.

The Facility inspects its first aid equipment regularly to assure that it is available when needed. The first aid and emergency response equipment are stored and tested as directed by their manufacturer and replaced on a schedule so that they will be effective when used.

The Nurse advised that all emergency medical kits are checked every three months by an outside service provider, Essential First Aid. The inspector notes the date of the inspection on a label on each kit. A spreadsheet was observed noting a sample of completed and scheduled inspections.

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The Oxysox are checked every six months by an outside service provider, Mediquip. A spreadsheet was observed noting a sample of completed and scheduled inspections.

Cyanokit antidotes are stored in the Occupational Health Centre fridge in accordance with manufacturers' storage instructions (<25°C and away from light). A weekly Safety Checklist is used by Plant Operators to perform checks on all safety showers, push button alarms, safety boxes incorporating eyewash bottles, fire hydrants, extinguishers, dust masks, Oxysox, Rescue Kits and toxic gas monitors.

The plant operators conduct weekly checks on the SCBA units. The checks are documented and stored for a 12-month period.

Safety data sheets (SDS) and first aid procedures on cyanide safety are in the language of the workforce and are available to workers at the site. All the signs and procedures are in English, which is the official language.

All site personnel have access to the Chemical Data Management System (CDMS) via the intranet. The CDMS is managed by Orica's Head Office in Melbourne. The CDMS was used during the audit to observe SDS for cyanide that conforms to both Australian and New Zealand Standards. Hard copies of SDS are also maintained in the Administration Building and the Control Room.

All employees, contractors and visitors are required to attend an induction before working at the Yarwun facility. The Induction video provides detailed information on the symptoms of cyanide poisoning and treatment methods. In addition, all employees are issued with a Basis of Safety – Sodium Cyanide Manufacture booklet produced by Orica. The booklet is designed to take learnings from past incidents and put them into a concise package of knowledge, with the aim of ensuring that future incidents are avoided or prevented. The booklet contains information on recognising the symptoms of cyanide poisoning and the procedure to follow in the event of exposure to cyanide.

The Yarwun facility has developed a formal Procedure titled Guidelines for Recognition and Medical Treatment of Cyanide Poisoning. This procedure covers the information in detail and is available to all personnel through the DMS.

Storage tanks, process tanks, containers and piping that contain cyanide are labelled to alert workers and identify their contents.

During the site walkover, lines observed were labelled to alert workers of their contents and direction of flow. All tanks observed were clearly labelled with individual tank identification numbers and emergency information panels.

The facility has a decontamination policy and procedures for employees, contractors and visitors leaving the areas with the potential for skin exposure to cyanide.

All visitors and facility workers receive induction training detailing information about the danger of cyanide, risks at the plant and safety information in general, including cyanide exposure procedures.

The decontamination procedure is discussed in initial training material, the NaCN Plant Normal Operating Instructions and Guidelines for Recognition and Medical Treatment of Cyanide Poisoning. The procedures detail the actions to be carried out by work personnel and visitors in the event of a potential contamination by cyanide. Anyone who suspects they may have ingested cyanide, or has come into contact with it in such a way that it may be absorbed through the skin, e.g. saturated clothing or incidental splashing, must follow the following in strict sequence:

- Alarm – activate the cyanide emergency alarm (e.g. radio, emergency button or pressure plate in shower)
- Shower – Remove all clothing and footwear and shower for a minimum of 2 minutes – or as directed by emergency responders.
- In addition to the shower, if cyanide has entered the mouth, commence and continue to spit, rinse, and spit until the mouth is free of cyanide.

Any contact with liquid within the cyanide plant is treated as a true exposure event and procedures are in place to ensure the affected person(s) are placed in an emergency shower, oxygenated, taken to the hospital and have blood samples collected. For the audit period there were a total of 27 potential exposure events, cyanide in blood concentrations were reviewed for each of these events, they ranged from 0.03 mg/L to 0.42 mg/L.

Of those tested, only one returned a blood cyanide level greater than 0.3 mg/L cyanide. The 0.3 mg/L limit is an internal measure used by Orica as a trigger for reporting a cyanide exposure incident. A reading of 0.5 mg/L limit is noted as being the international standard at which signs of cyanide poisoning are evident.

All such events are included as incidents in the Incident database and are followed up in accordance with the Incident Investigation procedure.

Plant Operators interviewed during the audit had a sound understanding of the procedure for cyanide exposure and decontamination and their responsibilities. The Basis of Safety booklet requires all employees to be familiar with the emergency response procedures.

The Facility has its own on-site capability to provide first aid to workers exposed to cyanide. The site has its own on-site capability to provide first aid or medical assistance to workers exposed to cyanide. The site has an on-site first-aid clinic.

Inspections and interviews conducted during the audit confirmed an on-site Occupational Health Centre is staffed by a Registered Nurse during day shift with an on-call system during the evenings.

In the event of a cyanide exposure, initial response will be administered by site medical staff prior to the injured person being transferred to Hospital via the patient transfer vehicle.

Emergency medical kits containing equipment suitable for the medical treatment of workers exposed to cyanide are located in all toxic refuges, and large emergency medical kits are located in both Control Rooms and the Occupational Health Centre. In addition to the Registered Nurse, all Plant Operators are required to have Advanced First Aid and Resuscitation Certifications which is required to be renewed annually.

Training records for a sample of Plant Operators were sighted.

In the event an antidote is required, it is administered by the trained medical staff at the Local Hospital. No antidote is administered on-site and as such, training in this is not required.

The Facility has developed procedures to transport exposed workers to locally qualified, off-site medical facilities.

It is the role of the Orica Company Doctor and the Site Occupational Health Nurse to visit the Local Hospital at least every two years to inform and educate hospital staff on the issues associated with cyanide exposure and confirm arrangements between the Yarwun facility and the local hospital regarding emergency response requirements. Additionally, the OEP states that as part of the development of the plan, emergency services in the Gladstone region along with local industry and the Gladstone Regional Council have been consulted.

In the event of a cyanide exposure, initial response will be administered by site medical staff prior to the injured person being transferred to the local hospital via the patient transfer vehicle. The injured person is accompanied during the journey and the cyanide antidote kit travels with the patient to the hospital. The patient transfer vehicle is stationed on-site and is available 24 hours a day.

In addition, the patient is sent to the hospital with a standardised letter advising the hospital staff that the patient has been referred for assessment following suspected exposure to cyanide. The letter also requests that the Senior Medical Officer, on-site, be notified upon the arrival of the patient.

The Facility has alerted local hospitals, clinics, etc. of the potential need to treat patients for cyanide exposure, and the facility is confident that the medical provider has adequate, qualified staff, equipment and expertise to respond to cyanide exposures.

It is the role of the Orica Company Doctor and the Site Occupational Health Nurse to visit the Local Hospital at least every two years to inform and educate hospital staff on the issues associated with cyanide exposure and confirm arrangements between the Yarwun facility and the local hospital regarding emergency response requirements. Additionally, the OEP states that as part of the development of the plan, emergency services in the Gladstone region along with local industry and the Gladstone Regional Council have been consulted.

Mock emergency drills are conducted periodically to test response procedures for various exposure scenarios.

A range of mock drills were conducted on site during the audit period. These ranged from internal exercises amongst shift crews, internal exercises facilitated by an outside provider and major drills involving external agencies.

Formal training is reinforced through a program of simulated emergency exercises. The Senior Specialist SHES- Safety is responsible for the publishing of an annual simulated emergency exercise plan and the Senior Product Line Managers, are responsible for the execution of the program. An exercise is required to be performed at a frequency of at least every six months. Both table-top and field-based exercises are performed. The simulated emergency program covers a range of emergency scenarios and all shift teams.

The program is used to test the adequacy of the site OEP and the emergency response procedures. During review of each exercise, suggested improvements are noted for implementation. The Senior Specialist SHES- Safety is responsible for ensuring that improvement actions are maintained in a register and activated in accordance with the designated priority.

The ERT training schedule put together by the training department is based on a three-yearly cycle and is split into two blocks, one is a training component and the other an emergency scenario.

In 2017 to 2018 there was an influx of new operations personnel to the site due to change in product demand and the focus was on getting the basic emergency response skills embedded into the crews through face to face training which took precedence over staged emergency exercises. In 2019 the training scenario reverted to Orica's standard format with the introduction of a major emergency scenario in the second block of the year for each crew. In 2019 the scenario was based upon a traffic incident with an ammonia tanker, resulting in a leak, this scenario covered off all of the skills that would also be applied to a major liquid cyanide spill or release of HCN gas type scenario.

The facility is required to meet a series of commitments in order to maintain its Major Hazard Facility license, one of these commitments is to run emergency response scenarios over the next five years that will test the knowledge and response capability of the ERT crews core skills that must be applied in response to a series of emergency events.

Procedures are in place to investigate and evaluate cyanide exposure incidents to determine if the operations programmes and procedures, to protect worker health and safety and to respond to cyanide exposures, are adequate or need to be revised.

The Incident Management and Corrective Action procedure defines the requirements for immediate action, classification, reporting and investigation and corrective actions of Safety, Health, Environment and Security incidents.

The scope of this procedure applies to all events, including cyanide exposures, which may:

- Cause or have the potential to cause injury, illness, damage or loss to company assets, damage to the environment or public alarm and/or
- Are potentially notifiable to the relevant statutory authorities, including matters which may have national security implications involving Dangerous Goods.

A sample of investigations reports were reviewed for reported incidents during the period. The reports included an assessment of the root causes and actions for prevention. As a result of the reports and investigations the facility has initiated an improvement program on the cyanide facility to minimise potential exposures via plant and equipment leaks. The Yarwun Site Cyanide Exposure Improvements Program aims to imbed an operating philosophy around prevention of leaks before they appear and establish a methods to deal with any leaks as they appear in an urgent and effective manner.

2.3 Principle 3 – Monitoring

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

2.3.1 Production Practice 3.1

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

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 3.1**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 3.1 requiring environmental monitoring to be conducted to confirm that planned or unplanned releases of cyanide do not result in adverse impacts.

The Facility does not have a direct discharge to surface water under normal operating conditions.

The facility uses a segregated stormwater system to capture, monitor, and if required, treat wastewater prior to discharging from licensed discharge points.

The facility has identified two separate effluent streams and manages them accordingly. Stormwater with no potential for contamination by cyanide flows off-site into natural drainage systems, whilst stormwater from within the cyanide production plant is channelled to a stormwater diversion system. The diversion system is equipped with a 3 ML capacity, retention pit. The pit has been installed to meet the environmental requirements of the regulatory authorities and is located on Orica's property, outside of the northern perimeter fence. The diversion pit only collects stormwater from Orica's Chemicals Complex (CC) and is a safeguard to prevent contaminated stormwater from being discharged to the environment. The stormwater diversion system also provides backup to the on-site first flush system.

Surrounding the cyanide plant is an impermeable surface designed to collect and direct run-off to a designated sump, this area, together with specific floors of the plant which receive direct rainfall, is drained to the First Flush Sump. The current operation of the first flush system is to collect the first 10 mm of rainfall and redirect any subsequent run-off to the Rainfall Event Management (REM) Tank. This ensures that any cyanide contaminated water is captured for recovery and/or treatment, rather than washed to stormwater. At the conclusion of the downpour the contents of the first flush sump and the REM tank can be pumped to two main effluent storage and treatment tanks, this prepares the First Flush System for the next rainfall event.

Both the stormwater diversion system pit and the First Flush Sump can be pumped to the two main effluent tanks situated on-site between the plant and the stormwater diversion pit. Within the effluent tanks, dilution and treatment (sodium hypochlorite dosing) may be used to remove any remaining cyanide from the water in order to meet site discharge criteria. The effluent ponds are tested before wastewater can be released from site, to a third-party managed, trade waste effluent facility. This trade waste facility was not included within the scope of this Recertification Audit. From the third-party operated trade waste facility, wastewater is discharged to the ocean.

The Yarwun site is governed by the Environmental Authority (EA) EPPR00872013. This document is administered by the Department of Environment and Science (DES). The EA contains effluent and stormwater release limits for cyanide. The EA only references free cyanide, however, the facility monitors for Weak Acid Dissociable (WAD) and total cyanide as well. The EA specified release limits are as follows:

- Chemicals Complex via third-party trade waste tank: 1 mg/L free cyanide
- Chemicals Complex stormwater recovery system: 1 mg/L free cyanide
- Chemicals Complex stormwater: 0.011 (normal operation) and 0.077 (high-rainfall event) mg/L free cyanide.

The EA and the Stormwater Management Plan contain the required monitoring frequencies for the above-mentioned effluent streams and discharge points.

The facility does not have an indirect discharge to surface water.

A network of groundwater monitoring bores is monitored for cyanide on a regular basis. Groundwater quality results confirm that there is still evidence of a historical plume of groundwater contamination associated with impacts from the cyanide plant. A historical mechanical failure of the solids dissolving tank, detected around 20 years ago, was identified as the likely cause. The most recent groundwater monitoring event (GME); supported by the most recent review of the site's groundwater conceptual site model (CSM), found that free cyanide remains present at concentrations exceeding the ANZAST 2018 screening values in groundwater on the site. The highest concentrations are associated with the cyanide plant and the free cyanide plume is within the site boundaries. Total cyanide has also been identified in groundwater with low concentrations being identified at the site boundary. Both a Remediation Action Plan (RAP) and a Contamination Action Plan (CAP) have been implemented at the site.

Reported contaminant concentrations in groundwater (and surface water) at the Yarwun facility have not resulted in measurable adverse effects in the receiving environment. Groundwater investigation reports include maps of the interpreted plume of cyanide-contaminated groundwater and indicate that cyanide concentrations are generally within historical ranges.

There are no surface water streams within the Yarwun facility and therefore no opportunity for seepage of groundwater via this pathway.

Free cyanide concentrations (or other species of cyanide for which there is a numerical standard established by the applicable jurisdiction) in groundwater at compliance points below or downgradient of the Yarwun facility are generally at or below levels that are protective of identified beneficial uses of the groundwater.

The most recent GME; supported by the most recent review of the site's groundwater CSM, found that free cyanide remains present at concentrations exceeding the ANZAST 2018 screening values in groundwater at some monitoring locations on the site. Concentrations of free cyanide in groundwater that exceed the relevant trigger value have been delineated within the site boundary with no detected concentrations of total cyanide in the downgradient monitoring wells on the east side of Reid Road. Therefore, this indicates that total cyanide in groundwater has not migrated to the receiving environment.

The protected beneficial use of groundwater downstream of the Yarwun facility is the ecosystem functioning of a forested wetland supported by sand flats to the north-east of the Yarwun facility, approximately 150 m from the boundary fence. The facility holds an approved EA from the DES. The authorisation requires groundwater monitoring but no numerical standard is referenced on the permit for cyanide in order to define the concentration protective of the beneficial use. In the absence of a standards specifically defined for the site and its locality, the Yarwun facility has adopted the ANZAST 2018 Guidelines of 0.011 mg/L for free cyanide. These Guidelines are the primary reference used by environmental regulators in Australia when determining environmental quality objectives for the protection of beneficial uses.

The EA only references free cyanide, however, in annual monitoring events, Orica analyse for both WAD and total cyanide levels as well. The facility has advised that independent testing results have shown WAD results to be similar to the free cyanide results and as such, they use free cyanide as the more conservative result. Of significance, the regulator has accepted monitoring of free cyanide as an effective indicator that the operation has operated within the intent of its obligations.

The most recent GME, completed in February 2020 found that concentrations of contaminants of concern (COC) are generally within the concentration ranges of the previous sampling rounds for the perched and shallow aquifer, but it noted new historical maximum concentrations for cyanide species in:

- Six locations in the perched aquifer
- Three locations in the shallow aquifer.

As a result of these findings, Orica commenced an investigation to understand why there were new maximum concentrations being detected at particular sampling locations. This investigation involved the resampling of six perched groundwater monitoring wells in March 2020. The six wells were redeveloped prior to sampling and the subsequent analytical results were substantially lower than those reported in February 2020 at the boundary wells. The elevated concentrations reported in July 2019 and February 2020 may have been influenced by cross contamination and are not considered reliable. To further assess potential causes of the changes in cyanide concentrations, a review of fluid electrical conductivity (salinity) was also undertaken and no significant (>10-20%) changes were observed that would indicate high/low recharge was the cause of the cyanide variability. It is noted that the concentrations of cyanide in wells located at the toe of the free cyanide plume remained consistent for all rounds of sampling and these results are considered reliable.

Seepage from the Yarwun facility has caused the cyanide concentration of the groundwater beneath the site to exceed that necessary to protect its beneficial use. The Yarwun facility is engaged in ongoing remedial activity to prevent further degradation and restore beneficial uses.

There are no ground water limits established in the Environmental Authority and the protected beneficial use of groundwater downstream of the Yarwun facility is the ecosystem functioning of a forested wetland supported by sand flats to the north-east of the Yarwun facility.

Reported contaminant concentrations in groundwater (and surface water) at the Yarwun facility have not resulted in measurable adverse effects in the receiving environment. Groundwater investigation reports include maps of the interpreted plume of cyanide-contaminated groundwater and indicate that cyanide concentrations are generally within historical ranges.

Concentrations of free cyanide in groundwater that exceed the relevant trigger value have been delineated within the site boundary with no detected concentrations of total cyanide in the downgradient monitoring wells on the east side of Reid Road. This indicates that total cyanide in groundwater has not migrated to the receiving environment.

The current remediation strategy for the site (developed by JBS & G) is monitored natural attenuation (MNA).

The remediation methodology of MNA requires that contaminant (free cyanide) concentrations are stable or contracting. While the latest annual groundwater monitoring report indicates a majority of wells display stable or decreasing concentrations, the statistical trend analysis identified an increasing trend (based on the last five years of data) for a number of locations immediately downgradient or adjacent to the source zone. The reported trends and concentrations in the downgradient plume potentially indicate that the plume is not currently stable.

An increasing trend has also been identified for total cyanide concentrations in the plume immediately downgradient of the source area. While total cyanide is not considered to pose a risk to the offsite/receiving environment, the reported concentrations are potentially characteristic of plume migration.

The MNA strategy, as developed by JBS & G, requires the facility to maintain a monitoring program to assess if additional remediation strategies for cyanide are required. If monitoring suggests plume concentrations are increasing or the plume is expanding, then further remediation works will be carried out.

The JBS & G (2020) report provides the following with regards to further remediation works:

- Initial steps would include the completion of a field pilot trial of in-situ bioremediation
- Pending the results of this trial the implementation of full scale in-situ bioremediation or groundwater extraction and treatment.

In addition to the above monitoring program, the facility has implemented the following steps as a result of the recently detected cyanide (in groundwater) levels:

- Underground pipework was integrity checked, with the only evidence of potential leaking (two locations) identified in an area where cyanide is not present
- Integrity checks of bunds were recently completed as an Environmental Protection Order (EPO) requirement
- Cyanide personnel completed an inspection on the annular space of the solids dissolving tank (inground tank); the inspection did not indicate a leak from the annular space, though more detailed testing is planned
- An action has been created for all in ground floor drains to have an integrity check completed during the next cyanide shutdown event. This will include the drains that were lined with stainless steel during the last shutdown, and the drain and sump associated with collecting water from around the sparge filling area.

The results of the ongoing monitoring program, and the findings from targeted inspections, continue to inform on the suitability of MNA as a remediation approach.

The facility limits the atmospheric emissions of hydrogen cyanide gas such that the health of workers and the community are protected.

The facility has the following licensed atmospheric discharge point for the cyanide plant:

- CN Drier Scrubber Vent 1/2/Warehouse Extraction Cyclone, regulatory release points 4C/9C/C24.

Engineering controls for minimising emissions of hydrogen cyanide include the following:

- Limited inventory of HCN within process equipment and piping
- Use of fully welded equipment joints in preference to flanged connections wherever possible
- Pressure testing of the HCN Converter and associated equipment in HCN service prior to start-ups to ensure no leaks
- Operation under vacuum at the solids processing (back end) of the plant
- A Tail Gas Burner that destroys cyanide in the air stream exhausted to atmosphere from the HCN Converter/Selective Absorber process. The Tail Gas Burner is backed up by an elevated flare stack
- Cyclones and a scrubber system (caustic adsorption) are used to remove dust and remaining traces of cyanide before vented air is released to the atmosphere from the driers.

The licence limit for the above release point is 35 mg/Nm^3 (dry) for gaseous hydrogen cyanide and 70 mg/Nm^3 (dry) for particulate sodium cyanide. Monitoring is conducted annually, though this can be scaled up or down based on results. Monitoring of these parameters is conducted by a third party with appropriate testing certification.

The most recent emissions monitoring program found that all results for sources on the cyanide plant were compliant with licence limits. The results were as follows:

- 4C: 0.916 mg/Nm^3 gaseous; 0.196 mg/Nm^3 particulate
- 9C: 0.76 mg/Nm^3 gaseous; 0.195 mg/Nm^3 particulate
- C24: 0.591 mg/Nm^3 gaseous; 0.140 mg/Nm^3 particulate.

Personnel limits are based on HCN concentrations in air of 10 ppm instantaneously and 4.7 ppm continuously over eight hours.

The facility does monitor for cyanide in discharges to surface water and in groundwater both up and down gradient of the site.

Discharges to surface water are monitored in accordance with the information provided.

Previous groundwater investigations at the site included detailed reviews of COC, of which one is cyanide. Groundwater monitoring for the identified COCs is undertaken on an annual basis, and biannually at key locations.

The most recent GME, completed in February 2020 found that concentrations of COC are generally within the concentration ranges of the previous sampling rounds for the perched and shallow aquifer, but it noted new historical maximum concentrations for cyanide species in:

- Six locations in the perched aquifer
- Three locations in the shallow aquifer.

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

The facility's current EA does not specify wells to be sampled, parameters or a sampling frequency, though it does require the submission of an "Annual Groundwater Report" addressing, amongst other things, an assessment of groundwater quality results and an assessment of the potential for environmental harm. Monitoring is conducted at frequencies adequate to satisfy this operating condition.

2.4 Principle 4 – Training

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

2.4.1 Production Practice 4.1

Train employees to operate the plant in a manner that minimises the potential for cyanide exposures and releases.

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 4.1**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 4.1 requiring employees to be trained to operate the plant in a manner that minimises the potential for cyanide exposures and releases.

The operation does train workers to understand the hazards of cyanide and refresher training is periodically conducted.

The Site maintains a training matrix, which outlines minimum training requirements for staff positions, and relevant contractors, across operational areas. The training includes site inductions and Cyanide Basis of Safety training material which is a requirement for all employees and contractors who work in or near operational cyanide areas. The training and induction material provides awareness of cyanide hazards, minimum PPE requirements, cyanide management controls, response to spills and emergencies, and basic first aid requirements.

Cyanide Basis of Safety training has a validity of three years before refresher training is required to be completed. Employees and relevant contractors who undertake work on the plant are required to re-sit the General Site Induction every two years. Employees are trained prior to working with cyanide and undertake competency based training depending on their position. These training requirements are outlined in the training plan document and are managed/tracked in the Learning Management System. There are automatic notifications for training requirements, and training material is reviewed every two years.

Interviews with personnel and personnel training files confirmed that workers are trained in cyanide hazards prior to undertaking works and refresher training is provided.

The Facility trains workers in the use of personal protective equipment (PPE) and when and where this equipment is required.

PPE training is covered in site inductions, Cyanide Basis of Safety training and job specific training materials. There are specific management and departmental procedures regarding PPE storage, maintenance and which type of PPE is required in the different operations.

The minimum cyanide PPE identified in the training materials are listed below:

- Hard hat
- Overalls
- Safety glasses

- Hearing protection
- Second layer of clothing (under overalls)
- Safety boots
- Chemical gloves.

Interviews with employees confirmed that training on how and when to use PPE is provided.

The Facility trains workers to perform their normal production tasks with minimum risk to worker health and safety and in a manner that prevents unplanned cyanide releases.

The Site maintains a training matrix, which outlines minimum training requirements for staff positions. Employees are trained prior to working with cyanide and undertake specific competency based training to perform tasks. New employees are partnered with experienced operators to learn the job and must demonstrate competency prior to working unsupervised. The training and induction material provides awareness of cyanide hazards, minimum PPE requirements, cyanide management controls, response to spills and emergencies, and basic first aid requirements.

The training elements necessary for each job are identified in training materials.

The Site training matrix identifies the training materials, including site inductions, SHEC program, Basis of Safety Program, emergency response, health, and safety requirements etc., and also specific training elements necessary for each job.

Training is provided by appropriately qualified personnel.

Training is provided in each functional operational area by appropriately trained subject matter specialists. These trainers are generally experienced operational employees with significant expertise and experience in the operations.

Employees are trained prior to allowing them to work with cyanide.

Workers must complete the specific training materials for their position, as identified in the training matrix, and demonstrate competency before being allowed to perform work. New employees are also teamed with an experienced operator for a period of time until they are deemed competent, this is generally in the order of four to six weeks but varies according to the complexity of the work area. New employees are not permitted to work unsupervised until the supervisor is satisfied that the person can complete the necessary tasks safely in accordance with procedures.

The Site evaluates the effectiveness of cyanide training by testing and observation.

Yarwun training is competency based. Evaluation is required to confirm competency standards have been achieved. Competency and training evaluations methods vary and include:

- Written assessment
- Oral assessment
- Practical demonstration
- Observation of behaviours.

The Plant Operator assessments are based on national competency requirements. New personnel are teamed up with an experienced operator and must demonstrate competency before being allowed to perform work unsupervised.

2.4.2 Production Practice 4.2

Train employees to respond to cyanide exposures and releases.

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 4.2**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 4.2 requiring employees to be trained to respond to cyanide exposures and releases.

The Facility does train workers in the procedures to be followed if a cyanide release is discovered.

Workers are trained in procedures to be followed if a cyanide release is discovered during inductions, Basis of Safety training and job specific training.

Workers interviewed could describe the response processes including evacuation to an upwind location, use of safety showers, raising the alarm and reporting the incident and how the use of cyanide antidotes is only carried out by medical professionals. The Site also has dedicated emergency responders that are trained in higher level response actions.

The Facility does train workers to respond to worker exposure to cyanide and routine drills are used to test and improve their response skills.

Mock drills are conducted with workers to train them and test their response skills. The facility has conducted worker exposure scenarios. The drills are recorded and reports assess the performance of the exercise and improvements needed.

Emergency drills are evaluated from a training aspect to determine if personnel have the knowledge and skills required for effective response. The drills are recorded in the Emergency Response Debrief Document and these reports assess the performance of the exercise and if improvements are needed.

If required, corrective actions are developed, assigned, and entered into the EHS management system (Enablon) for implementation and tracking.

Training records are retained throughout an individual's employment, documenting the training they have received and including the names of the employee and the trainer, the date of training, the topics covered, and how the employee demonstrated an understanding of the training materials.

Electronic training records for members of the facility were reviewed and contained evidence of training including course content, assessments, and certificates.

All workers receive training on personal protective equipment and emergency response procedures during a spill or exposure in site inductions and Basis of Safety training.

2.5 Principle 5 – Emergency Response

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

2.5.1 Production Practice 5.1

Prepare detailed emergency response plans for potential cyanide releases.

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 5.1**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 5.1 requiring a detailed emergency response plan for potential cyanide releases.

The Facility has developed an Emergency Response Plan to address potential releases of cyanide that may occur on site or may otherwise require a response.

The Yarwun Operations Emergency Plan (OEP) has been developed to:

- Outline the response to emergency situations at the site
- Identify potential emergency scenarios and define combat strategies that control or limit any effect that an emergency or potential emergency may have on personnel, the site/business, the facilities, and neighbouring areas
- Ensure communication of vital information as soon as possible to both internal company management and as appropriate external authorities, agencies and or neighbours
- Facilitate the reorganisation and reconstruction activities so that normal operations can be resumed
- Provide a reference for training so that a high level of preparedness can be continually maintained.

The OEP is the key document describing the response actions for site personnel during an internal emergency. The OEP was developed in accordance with the Orica corporate emergency response requirements detailed in Orica Group Procedure SHES Emergency Management.

The OEP is supported by the Orica Mining Chemicals Emergency Response Guide – Sodium Cyanide (ERG). This Cyanide ERG has been developed by Orica Mining Chemicals to provide guidance in the development of specific site and transport route emergency response plans for the management of incidents involving spillage of cyanide product.

The ERG is intended to be used in conjunction with technical advice supplied, as required, by Orica Mining Chemicals personnel and other emergency response service personnel. The ERG is applicable to the management of an emergency involving Orica supplied cyanide solid or liquor product and is considered to be applicable to emergency scenarios involving product spillages at any location along the supply chain.

The operations emergency response plan does consider the potential failure scenarios appropriate for site-specific environmental and operating circumstances.

The types of major incidents covered by the OEP includes loss of containment of hazardous substances, toxic gas releases, explosions, fires, natural disasters, bomb threats, and security incidents. Each potential emergency scenario is denoted as a Major Safety Hazard Scenario within Appendix D of the OEP. Each scenario is derived from the Yarwun Safety Case assessment, a site-specific risk assessment. The Safety Case documentation is the primary requisite for maintaining a Major Hazard Facility (MHF) License.

A Safety Case is a document produced by the operator of a facility which:

- Identifies the hazards and risks
- Describes how the risks are controlled
- Describes the safety management system in place to ensure the controls are effectively and consistently applied.

Safety cases must be produced by the operator of an installation, thereby enforcing a principle of “those who create the risk must manage it.” It is the operators' responsibility to assess their processes, procedures, and systems to identify and evaluate risks and implement the appropriate controls. A Safety Case assessment must identify the safety critical aspects of the facility, both technical and managerial. Appropriate performance standards are defined for the operation of the safety critical aspects.

A 'performance standard' is a standard of the performance required of a system, item of equipment, person or procedure which is used as a basis for managing the risk of a major accident event. The workforce must be involved in the establishment of performance standards. Workforce involvement is a key step towards ensuring personnel know what happens in practice and understand why.

The safety case is reviewed and subsequently approved by a competent and independent regulator. The Hazardous Industries Chemical Branch (WH&S) assesses safety cases and approves a safety case if it is satisfied that the arrangements set out in the document demonstrate that the risks will be reduced to as low as is reasonably practicable (ALARP). Approved safety cases are routinely audited.

The OEP and the Safety Case documentation contain sufficient procedural information to allow responsible site personnel to respond to the scenarios identified in this question. Specific combat instructions for each incident are included in Appendix D of the OEP.

The operations emergency response plan describes specific response actions, as appropriate for the anticipated emergency situations.

Appendix D of the OEP contains response (combat strategies) for the following cyanide related emergency scenarios:

- Loss of containment of hydrogen cyanide
- Loss of containment of sodium cyanide during manufacturing
- Sodium cyanide poisoning
- Fire and explosion in the cyanide plant.

Within each combat strategy, as applicable, reference is made to evacuations, the use of the DCS and interlocks to control releases at their source and containment and remediation steps and the provision of first aid.

The Guidelines for Recognition and Medical Treatment of Cyanide Poisoning supports the OEP and provides additional information regarding the response actions and management of an emergency scenario involving cyanide exposure(s). This includes the use of cyanide antidotes and step by step first aid measures for cyanide exposure.

2.5.2 Production Practice 5.2

Involve site personnel and stakeholders in the planning process.

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 5.2**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 5.2 requiring the Facility to involving site personnel and stakeholders in the planning process.

Orica has involved its workforce and stakeholders in the emergency response planning process.

The OEP is the key emergency management document that describes the response actions for site personnel during an onsite emergency. The OEP was developed in accordance with the Orica corporate emergency response requirements and notes that employees and the relevant external community emergency service organisations shall be consulted during the development of the emergency plan. As a MHF, the operations' OEP must meet national legislated guidelines and pass an assessment by the Research and Scientific Branch of Queensland Fire and Emergency Services before a MHF license is issued (or renewed) for the facility.

The OEP states that as part of the development of the plan, emergency services in the Gladstone region along with local industry and the Gladstone Regional Council have been consulted. Additionally, to maintain effectiveness of the OEP, Orica continues to consult and discuss emergency response training and preparedness with its employees, industrial neighbours and the Queensland Fire and Emergency Services (QFES), through the Mutual Aid Group of Gladstone (MAGG).

The OEP identifies the following stakeholders:

- Workers in the area
- Site population including contractors
- Orica Senior Management
- Adjacent industry
- Community groups including the Gladstone Regional Council Disaster Management Group, MAGG and Gladstone Industry Leadership Group.
- Local Council
- Visitors and people passing through the local area
- Regulatory authorities associated with the Site's Licence to Operate.

Given the site is classed as a Major Hazards Facility, there is a requirement for a comprehensive assessment of Orica's risk structures and management systems by the Hazardous Chemical Industries Branch to ensure the nationally legislated standards are met before issuing or renewing a licence to operate. This process is repeated every five years.

The Orica Group Procedure – Safety, Health, Environment and Security (SHES) Emergency Management requires that Orica:

- Consult with employees, neighbours, regulators, and emergency services during development of emergency response plans. Include customers, where the site is located on customer's property.
- Provide all personnel with sufficient information about the emergency response plan during their induction, so that they know what actions to take in an emergency.
- Make emergency response plans available to external support agencies, statutory authorities, neighbours, and the public, as required by local regulations.

Orica is a founding member of the MAGG. This group consists of neighbouring major companies, emergency services personnel (Fire, Police, Ambulance), WH&S representatives and Local Government. The group meets quarterly to discuss emergency response. Through the group Orica involves the local stakeholders in the emergency response planning process.

During the audit period, relevant employees have been involved in the emergency response planning process through initial training and simulation exercises and debriefs. Employees are also involved in the planning and revision of site procedures and plans thorough the document review process.

Orica has made potentially affected communities aware of the nature of the risks associated with accidental cyanide releases but the potential emergency scenarios identified at the site are unlikely to affect or require actions by the community. Additionally, potentially affected neighbours consist only of other industrial sites.

As part of maintaining a MHF licence, the facility must issue a communique to the community that describes the operation and the risks associated with the site. It also includes a guide for what to do in an emergency.

In the event of an emergency one of the members of MAGG can request mutual aid and assistance will be provided. Through the regular group meetings, Orica involves their local stakeholders in the emergency response planning process.

In the event of an emergency that may impact the surrounding area, the Incident Management Team (IMT) would be initiated. The IMT is comprised of members of the Site Management Team and designated specialists. The role of the IMT is management of external interfaces and to provide technical support to the site's Incident Controller. The external interfaces include; the Orica Crisis Management Team, the media, next of kin contact and support, regulatory bodies, Local Government, and follow-up (as distinct from initial emergency or evacuation alert) assistance and control action advice to neighbouring companies and community groups.

The Facility has involved local response agencies such as outside responders and medical facilities in the emergency planning and response process.

The OEP states that as part of the development of the plan, emergency services in the Gladstone region along with local industry and the Gladstone Regional Council have been consulted. Additionally, to maintain effectiveness of the OEP, Orica continues to consult and discuss emergency response training and preparedness with its employees, industrial neighbours and the QFES, through the MAGG.

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Name of Facility	Signature of Lead Auditor	Date

The OEP identifies the following external stakeholders:

- Adjacent industry
- Community groups including the Gladstone Regional Council Disaster Management Group, Mutual Aid Group and Gladstone Industry Leadership Group
- Local Council
- Visitors and people passing through the local area
- Regulatory authorities associated with the Site's Licence to Operate.

The operation engages in regular consultation and communication with stakeholders to assure that the emergency response plan addresses current conditions and risks.

The facility has established processes to engage in regular consultation or communication with internal and external stakeholders.

The facility undertook a Safety Case Assessment in late 2018, workforce consultation mechanisms were considered in this assessment and there are several communication methods in use. The primary communication tool is the monthly site Safety, Health and Environment (SHE) Committee meeting managed by the SHE Manager. The SHE Committee minutes are saved on the Yarwun Site Lotus Notes Database which is accessible to all employees. The SHE Manager also sends an email after the meeting to all site employees containing a link to this folder.

There are monthly area toolbox talks within each operational area with records managed by the respective department leads.

Site Manager Communication sessions are held quarterly with employees containing a SHE component and site emails from the SHE Manager on relevant SHE issues affecting site.

All employees are involved throughout each year in planned emergency evacuation exercises managed by the Training Co-ordinator which test the effectiveness of the OEP. Many of the exercises involve evacuation from particular areas within the site and are based on a particular scenario occurring e.g. fire. Employees are trained, and expected, to follow the OEP and assemble at their nominated emergency assembly areas where a manual roll call is conducted.

Orica is on the Mutual Aid Response Group. This group consists meets quarterly to discuss emergency response. Through this group it is communicated what the current emergency response plan is at the Yarwun facility and what potential assistance is available. Orica can share ideas to determine if the plan is current and potential risks are addressed.

2.5.3 Production Practice 5.3

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

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 5.3**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 5.3 requiring designated appropriate personnel and committed equipment and resources for emergency response.

The emergency response documentation:

a) Does designate primary and alternate emergency response coordinators.

A section of the OEP identifies the Incident Controller (IC) as the Orica employee responsible for leading the emergency response team, generally this role is occupied by the facilitator of the plant affected by the incident. The IC may be relieved by a designated member of the QFES if external assistance is involved. Additionally, there is both an Incident Response Team (IRT) and an Incident Management Team (IMT) each with a designated leader during an emergency response.

b) Identifies Emergency Response Teams.

Orica Yarwun has both an IRT and IMT, each with different roles and responsibilities during an emergency situation. A section of the OEP describes the role of the IRT which is predominately based on physical response actions, the IRT is made up of shift personnel. Whilst the IMT is made up of members of site management teams and designated specialists, the IMT is responsible for external interfacing and providing technical support to the IRT.

c) Requires appropriate training for emergency responders.

A section of the OEP states the required emergency response training for all personnel onsite. At a minimum, all personnel are required to have completed the site safety induction, whilst personnel with an emergency services role are required to complete structured emergency response training units in accordance with nationally accredited competencies. Training details including frequencies and refresher training is contain in the site training matrix.

d) Includes call-out procedures and 24-h contact information for the coordinators and response team members.

An appendix of the OEP contains the list of contact information for notification of key personnel. This list includes off-site emergency contacts, neighbouring industrial contacts and other emergency services. Appendix Q details the afterhours emergency response and safe-haven access protocols, which include the steps to follow to notify key personnel outside of normal business hours.

e) Specifies the duties and responsibilities of the coordinators and team members.

A section of the OEP specifies the duties and responsibilities of the incident response teams.

f) Lists all emergency response equipment that should be available.

A section of the OEP provides a shortlist of emergency response resources available onsite, and accessible to all personnel. An appendix of the OEP contains a full manifest of emergency response equipment available to the IRT during an emergency event.

g) Includes procedures to inspect emergency response equipment and assure its availability when required.

An appendix of the OEP serves as a checklist for the accountability and storage location of emergency response equipment. Routine area checks also include consideration of the presence and working condition of emergency response equipment.

h) Describes the role of outside responders, medical facilities or communities in emergency response procedures.

The OEP states the role of the QFES in the event of an emergency situation requiring external assistance. Medical facilities have been made aware of their possible need to assist should the site clinic need to transfer a patient(s).

External responders, medical facilities and other outside entities have been advised of their roles and are aware of aid requirements during an emergency response. QFES would be the primary external responder in the event of a cyanide release scenario and the Department has been involved in major response exercise drills in the past.

Due to the nature of the facility, and specialised training requirements of qualified external responders, emergency response is largely self-contained and or limited to HAZMAT or other specialised agencies.

It is the role of the Orica Company Doctor and the Site Occupational Health Nurse to visit the Local Hospital at least every two years to inform and educate hospital staff on the issues associated with cyanide exposure and confirm arrangements between the Yarwun facility and the local hospital regarding emergency response requirements. The Occupational Health Nurse may also conduct independent visits to the hospital to deliver toolbox presentations on cyanide due to a high turnover of staff at the hospital.

All outside entities listed within the site OEP have been provided with a copy of the Plan. Outside entities are included within both tabletop and field exercises.

2.5.4 Production Practice 5.4

Develop procedures for internal and external emergency notification and reporting.

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 5.4**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 5.4 requiring development of procedures for internal and external emergency notification and reporting.

The OEP describes the procedure and provides contact information for notifying management, regulatory agencies, outside response providers and medical facilities as appropriate. The OEP contains an Emergency Response Plan – flow diagram which includes prompts for contacting external response providers. The contact names, numbers and contact instructions for key Orica contacts are contained within an appendix.

The OEP includes consideration of the role of outside responders including QFES and QLD Ambulance (Gladstone) who have been provided a copy of the plan. Notifications to local community industrial neighbours may be initiated via SMS text messaging service through the Orica Emergency Response Service, followed up by landline communication with the industrial neighbours that may be exposed to the event.

The emergency response documentation includes procedures and contact information for notifying potentially affected communities and communication with the media.

Notifications to local community industrial neighbours will be initiated via SMS text messaging service through Orica Emergency Response Service (ERS), this can be followed up by landline communication with the industrial neighbours that may be exposed to the event.

A member of the IMT is responsible for external communications and liaison with the media if applicable.

2.5.5 Production Practice 5.5

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

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 5.5**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 5.5 requiring the Facility to incorporate monitoring elements that account for the additional hazards of using cyanide treatment chemicals into response plans and remediation measures.

Procedures have been developed to describe specific, appropriate remediation measures, 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.

Decontamination of soil is managed in accordance with the sites Soil Management Plan and the Yarwun Waste Management Plan. The plans contain information on contaminants of concern and identify the requirements for free, WAD and total cyanide analyses. The Waste Management Plan contains management techniques for the handling and temporary storage of cyanide contaminated soil and provides the criteria that must be met for soil to disposed of offsite. The Soil Management Plan describes the process for Restorative Action and the development of a Restoration Action Plan on a case specific basis.

The Decontamination of Equipment in Cyanide Service procedure describes the decontamination process for cyanide equipment, requiring that it be treated within the area delineated by blue lines using hot condensate (>50°C), dilute sodium hypochlorite or weathering processes depending on the type of equipment and degree of contamination. The procedure describes monitoring techniques to confirm the equipment is free of contamination.

The Emergency Scenario Combat Strategies provide for delineation of the spill and the excavation of visibly impacted material for re-treatment within the plant. The area of the spill would then be tested using inhouse laboratory personnel following the procedures detailed in the Emergency Response Guide which provides a colourimetric presence/absence test for cyanide. The number and location of samples would be evaluated based on the characteristics of the spill and the environment in which it occurred to enable delineation.

Should residue remain and excavation not be practical, the area would be treated with 5% v/v solution of sodium hypochlorite solution and then dilution with copious amounts of water. Hypochlorite solution is stored in the cyanide complex utility shed with the Hazmat Trailer.

As outlined in the Emergency Response Guide, Orica would undertake soil testing for presence/absence of cyanide. The approach is not to leave cyanide residue within the environment from a spill or leak.

The cyanide plant is delineated by a blue line which defines the area where stormwater contaminated with cyanide can be controlled effectively. The Stormwater Diversion Pit located immediately outside the Yarwun facility boundary provides the means for contaminated stormwater to be recovered to the on-site Stormwater Diversion Pond at 70 m^3/h. From here it can also be returned to the Site Effluent Ponds for treatment as needed.

Drinking water for the region is supplied from Awonga Dam, approximately 25 km away and is not at risk from cyanide incidents. Local groundwater was reported to be too saline to be used as drinking water.

No natural surface waters are located within the Yarwun facility and consequently the Yarwun OEP does not contain a reference prohibiting the use of chemicals such as sodium hypochlorite, ferrous sulfate, and hydrogen peroxide to treat cyanide that has been released into surface water. However, the Cyanide Emergency Response Guide that has been developed for offsite releases and guides response actions should there be a release to surface water does include a clear prohibition on the use of these chemicals to treat cyanide release to surface waters.

Potentially cyanide impacted stormwater is contained on site and is tested prior to discharge. If impacted, it is pumped back to the plant for treatment or to trade waste if acceptance criteria are met.

The emergency response documentation does 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.

Decontamination of soil is managed in accordance with the sites Soil Management Plan and the Yarwun Waste Management Plan. The plans contain information on contaminants of concern and identify the requirements for free, WAD and total cyanide analyses. The Waste Management Plan contains management techniques for the handling and temporary storage of cyanide contaminated soil and provides the criteria that must be met for soil to disposed of offsite. The Soil Management Plan describes the process for Restorative Action and the development of a Restoration Action Plan on a case specific basis.

High-level monitoring requirements are referenced in an appendix of Combat Strategies, whilst the Yarwun Operations Emergency Management Plan contains post emergency environment management provisions. The plan states that where the environment has been, or has the potential to have been impacted by the release of materials, the following steps should be taken to manage the environmental impact:

- Collect samples of potential contaminants
- Engage environmental specialists to investigate the extent of incident and potential for environmental harm
- Develop remediation plan
- Implement waste management procedures as required.

2.5.6 Production Practice 5.6

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

	☒ **in full compliance with**	
The operation is	☐ in substantial compliance with	**Production Practice 5.6**
	☐ not in compliance with	

Summarise the basis for this Finding/Deficiencies Identified:

Orica is in FULL COMPLIANCE with Production Practice 5.6 requiring the Facility to periodically evaluate response procedures and capabilities and revise them as needed.

The emergency response documentation contains provisions for periodically reviewing and evaluating its adequacy and they are being implemented.

The OEP is subject to continuous improvement, and updated annually as a minimum or when deemed necessary, such as:

- Following an emergency incident
- Following a Near-Miss incident
- In conjunction with changes in legislation
- In conjunction with changes in the quantity or nature of the site's hazardous substances
- In conjunction with any update, revision or feedback on the MHF Safety Case
- In conjunction with changes to surrounding land use
- Following simulated emergency exercises
- Following audits
- As a result of consultation with QFES.

The emergency plan is currently revision 25 and was last updated in September 2019.

Mock emergency drills are conducted periodically to test response procedures for various exposure scenarios.

Formal training is reinforced through a program of simulated emergency exercises. The Senior Specialist SHES- Safety is responsible for the publishing of an annual simulated emergency exercise plan and the Product Line Managers, are responsible for the execution of the program. An exercise is required to be performed at a frequency of at least every six months. Both table-top and field-based exercises are performed. The simulated emergency program covers a range of emergency scenarios and all shift teams.

The program is used to test the adequacy of the OEP. During review of each exercise, suggested improvements are noted for implementation. The Senior Specialist SHES- Safety is responsible for ensuring that improvement actions are maintained in a register and activated in accordance with the designated priority.

The ERT training schedule put together by the training department is based on a three-yearly cycle and is split into two blocks, one is a training component and the other an emergency scenario.

In 2017 to 2018 there was an influx of new operations personnel to the site due to change in product demand and the focus was on getting the basic emergency response skills embedded into the crews through face to face training which took precedence over staged emergency exercises. In 2019 the training scenario reverted to Orica's standard format with the introduction of a major emergency scenario in the second block of the year for each crew. The practical component of the training program did include responding to cyanide exposure incidents. In addition to the programmed training, an exposure to a leak in the plant area is assumed to be cyanide and responded to accordingly. The operation responded to several potential cyanide exposures which tested response systems and response actions. None of the incidents resulted in cyanide poisoning. A review of incident investigation reports indicates response actions upon activation of the alarm aligned with procedures.

In 2019 the scenario was based upon a traffic incident with an ammonia tanker, resulting in a leak, this scenario covered off all of the skills that would also be applied to a major liquid cyanide spill or release of HCN gas type scenario.

The facility is required to meet a series of commitments in order to maintain its Major Hazard Facility license, one of these commitments is to run emergency response scenarios over the next five years that will test the knowledge and response capability of the ERT crews core skills that must be applied in response to a series of emergency events.

The facility has provisions to evaluate the plan after an emergency that required implementation of the plan, and for revising the plan as necessary.

The OEP is subject to continuous improvement, and updated annually as a minimum or when deemed necessary, such as:

- Following an emergency incident
- Following a Near-Miss incident
- In conjunction with changes in legislation
- In conjunction with changes in the quantity or nature of the site's hazardous substances
- In conjunction with any update, revision or feedback on the MHF Safety Case
- In conjunction with changes to surrounding land use
- Following simulated emergency exercises
- Following audits
- As a result of consultation with QFES.

The post mock drill evaluation documents for 2017, 2018 and 2019 were reviewed during the site audit which showed that no deficiencies were identified during the mock drill evaluation meeting. There have been no cyanide related emergencies in the period since the last ICMC audit.

3.0 IMPORTANT INFORMATION

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

Orica Yarwun Production Facility		11 September 2020
Name of Facility	Signature of Lead Auditor	Date

Signature Page

Golder Associates Pty Ltd

Craig Currie
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ICMI Lead Auditor/Production Technical Specialist

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https://golderassociates.sharepoint.com/sites/119662/project files/6 deliverables/19135110-004-r-rev0 orica yarwun, summary audit report.docx

APPENDIX A

Important Information

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