



Sec 21 Information Framework for Collision Prevention Systems:

INDUSTRY ALIGNMENT ON TMM REGULATIONS; SPECIAL PROJECT OF THE
MINERALS COUNCIL SOUTH AFRICA

REV 2

Sec 21 Information Framework Acceptance			
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APPROVED

1. Purpose of this document

Designers, manufacturers and/or suppliers of CxDs, TMM CPS and Third-Party OEM interface solutions providers must comply with Section 21 of Chapter 2 of the Mine Health and Safety Act.

Demonstrating compliance can be achieved by compiling a Technical File, based on this document, for approval by the mine site representative(s).

The purpose of the Section 21 Technical File Content (this document) is to define the structure and content for CPS supplier's information in accordance with the requirements and readiness criteria of the INDUSTRY ALIGNMENT ON TMM REGULATIONS; SPECIAL PROJECT OF THE MINERALS COUNCIL SOUTH AFRICA.

This document provides guidelines for:

1. the information to be compiled, stored, and made available,
2. processes and methodologies for collating the information while implementing and managing CPS product development,
3. a checklist to be used by internal and external verification/compliance officers.

2. Definitions and abbreviations

The following definitions and abbreviations were used in this document.

Article	<p>A CPS, its elements or any sub systems as defined in the CPS functional breakdown structure, that can pose a health or safety risk to employees including, but not limited to:</p> <ul style="list-style-type: none"> • TMM CPS, and • CxD, <p>Note 1: see Figure 1 for the CPS functional breakdown structure.</p> <p>Note 2: see Figure 2 for further definition of "any, an, and the article".</p>
Any or every person	<p>Means any person (including employee or contractor) or supplier who supplies, designs, manufactures, constructs, or installs any article or structure, or supplies hazardous substances to SAMI.</p> <p>Note 1: Any is a random pick of one or a few.</p> <p>Note 2: Every includes all of a set or group.</p> <p>Note 3: Any and every member of a group means all the members of that group.</p>

CoC	Certificate of Conformance or Conformity. Is a document issued by any person with such authority within the supply organisation to confirm that the product has been manufactured with test results showing conformance to the reference documents (applicable documents) specified in this document.
Configuration Management	Configuration management (CM) is the field of management focused on establishing and maintaining the consistency of its system or product performance and its functional and physical attributes. The system and product requirements, design, and operational information documentation must be maintained and available throughout its life. Through the control of changes the configuration process manages the security features and assurances throughout the life cycle of an information system to hardware, software, firmware, documentation, test, test fixtures, and test documentation
CPS	Collision Prevention System: A Product System that comprises the functionality and characteristics that comply with the RSA TMM collision prevention regulations. (TMM Regulations 8.10.1 and 8.10.2 and user requirements.) See Figure 1 for the CPS functional breakdown structure.
CPS product provider	Any person supplying or providing any element or sub system in the CPS.
CPS Developer	The single integration organisation as agreed between all providers (persons) providing a specific CPS product i.e. A CxD, a TMM CPS and or an interface technology.
CWAS/(CxD)	Collision Warning and Avoidance System device (CxD): Device with sensors providing collision warning and avoidance functions, to detect objects in the vicinity of the machine, assess the collision risk level, effectively warn the operator of the presence of object(s) and/or provide signals to the machine control system, to initiate the appropriate interventional collision avoidance action on the machine, to prevent the collision. Note to entry: Proximity Detection System (PDS) is a colloquial industry term for a physical device, providing a warning or collision avoidance functionality.
CxD	Collision warning/detection/management Device.
DMRE	Department of Mineral Resources and Energy.
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference

EMESRT	Earth Moving Equipment Safety Round Table
Employee	Employee means any person who is employed or working at a mine.
Functional Specification	Specifications that define the function, duty, or role of the product/system. Functional specifications define the task or desired result, by focusing on what is to be achieved, rather than how it is to be done.
F	Function: Indicates a function of the CPS or functional group.
FMECA	Failure Mode Effect and Criticality Analysis
FTS	Fail to Safe: The functionality that will bring a TMM to a controlled stop
G	General: Indicates a general requirement that is applicable to the entire CPS and all of its elements, modules, and components.
ICASA	<i>Independent Communications Authority of South Africa</i>
ICMM	International Council on Mining and Metals.
ID	Identifier.
Independent	Separate from the CPS product developer. Note: Independent does not imply an accredited 3 rd party, although where required by local or international standards, it includes accredited 3 rd parties.
Independent person	A person, typically a test-, software- or EM engineer, who is not affiliated with the CPS provider or TMM OEM, that can provide an unbiased assessment.
Interface	A boundary across which two independent systems meet and act on/or communicate with each other notably: examples: 1. CxD-machine interface – The interface between a Collision Warning and Avoidance System Device (CxD) and the machine. This interface is described in ISO/DTS21815-2. 2. Note: An interface implies that two separate parties (independent systems), are interacting with each other, which may present interoperability and/or EMI and EMC challenges.
Minerals Council	Minerals Council South Africa.
MHS Act	Mine Health and Safety Act No. 29 of 1996 and Regulations.
MHSC	Mine Health and Safety Council.

PDS	Proximity Detection System – see CxD.
Pedestrian	A person lying, sitting, or walking rather than travelling in a vehicle.
Project	Industry Alignment on TMM Collision Management Systems Project: CAS READINESS PHASE.
PWS	Pedestrian warning System: The system that provides the effective warning to pedestrians.
Quality Assurance	Verifying a process, product, or service; usually conducted by an experienced person in the specific field.
Reasonably practicable measure	Reasonably practicable means practicable with regards to: (a) The severity and scope of the hazard, or risk concerned. (b) The state of knowledge reasonably available, concerning the hazard or risk, and of any means of removing or mitigating the hazard or risk. (c) The availability and suitability of means to remove or mitigate that hazard or risk, and (d) The costs and the benefits of removing or mitigating that hazard or risk.
SAMI	South African Mining Industry.
System	A combination of interacting elements organized to achieve one or more stated purposes (ISO/IEC/IEEE 2015).
T	Technical: Indicates a technical requirement of the CPS or functional group.
Technical specification	Specifications that define the technical and physical characteristics and/or measurements of a product, such as physical aspects (e.g., dimensions, colour, and surface finish), design details, material properties, energy requirements, processes, maintenance requirements and operational requirements.
Stage gate	A step in the testing regime / process where the CPS product system is tested against acceptance criteria, the failure of which would limit the CPS product system from moving to the next step in the regime / process.
This document	MHSA Section 21 file for CPS – Information framework.

TMM	<p>Trackless Mobile Machine. (Machine, vehicle, etc.)</p> <p>Trackless Mobile Machine means any self-propelled mobile machine that is used for the purpose of performing mining, transport or associated operations underground or on surface at a mine and is mobile by virtue of its movement on wheels, skids, tracks, mechanical shoes or any other device fitted to the machine, but excludes :</p> <ul style="list-style-type: none"> • Rail bound equipment; and • Scraper winches, monorail installations, static winches, winding machinery installations and any equipment attached thereto.
TMM OEM	Original Equipment Manufacturer of TMMs. Original Equipment Manufacturer of a TMM may be the organisation which originally supplied, or last rebuilt, or modified the TMM, or the supplier per section 21 of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).
TMM CPS	The functional group comprising all TMM CPS related functions.
TMM CPS Product	The product that will make a non-intelligent TMM intelligent and CxD ready.
TRL	Technology Readiness Level: A technology maturity framework for measuring and monitoring technology maturity in 9 increasing levels from TRL 1 to TRL 9.
3 rd Party	An entity appointed to execute work (testing, witnessing of testing and verifying portfolios of evidence) on behalf of SAMI. Note: The purpose of 3 rd party execution is to establish independence and to eliminate duplication.

3. Background

Collision Prevention Systems are required by Section 8.10.1 and 8.10.2 of the MHS Act where other controls are ineffective to prevent TMM collisions. Two of the clauses of the regulations 8.10.1.2b and 8.10.2.1b have been suspended. The suspension will be lifted up at end of 2023. Because CPS is a safety system, and the application of the technology is novel and unique to South Africa, a specific focus on the requirements, the development and verification processes of CPS products is necessary. As part of the **Industry Alignment on TMM Regulations; Special Project of The Minerals Council South Africa**, Applicable Documents 4 and 5 define the CPS requirements and the functional readiness criteria, while Applicable Document 6 defines the CPS testing requirements. Conformance to the requirements of these four documents is considered the **minimum reasonably practicable measures** that a CPS product provider must take to **ensure compliance** to the requirements of Section 21 of the MHS Act.

4. South African Mining Industry (SAMI) approach to Sec 21 compliance for CPS

The SAMI's approach to Sec 21 compliance for CPS is:

- CPS product or element providers are **accountable and responsible** to ensure compliance,
- Providers must **demonstrate** compliance by:
 - Conforming to requirements of its own organisation's product development and verification policies and processes,
 - Conforming to minimum requirements as defined by the SAMI, and
 - Managing all **changes and upgrades** to its products with the same processes.
- To ensure that mines have unambiguous definitions of how to use CPS products properly, CPS product/element providers must deliver their products with at least:
 - Risk assessments
 - Commissioning and testing procedures,
 - Operator Manuals,
 - Maintenance Manuals (including spares lists),
 - Fault Finding Manuals,
 - Training manuals,

- Train the trainer guidelines.

5. Frequently Asked Questions

Since the purpose of this document is to provide a Section 21 Technical File content framework for information to be included in a CPS Technical “File” a key question is:

Question: Does Section 21 of the MHS Act require that a **physical** file must be produced?

Answer: Section 21 does not require that a physical file must be produced. The question must therefore be restated:

Question: “How will the SAMI ensure that CPS suppliers will demonstrate that they supply CPS products that are without risk to the health and safety of SAMI employees?”

Answer: Compliance cannot be achieved without a logical information trail that clearly demonstrates that the CPS product(s) conform with the minimum requirements and criteria that will ensure that CPS products perform as per user requirements and mine specific risk assessments.

Questions: Must a Technical File be delivered with every CPS product?

Answer: A CPS product provider must be able to demonstrate conformance to requirements and standards to comply. Demonstration does not imply delivery of a technical file with every CPS product.

A mine will have many CPS systems in its operations. A CPS system comprises a CxD product and a TMM CPS product. This means that every different TMM Type and model (and in some cases serial number) is a different CPS System. For interoperability purposes a mine can have only 1x CxD supplier. It will not add value to duplicate a CxD technical file for each CPS system on a mine.

The philosophy to ensure minimum duplication, effort and optimum Section 21 compliance is:

- CPS product providers develop, collate, and store its CPS product Technical File as set out in this document (see Figures 5, 6 and 7).
- A CPS Certificate of Conformance supported by a single certificate of conformance per Technology Readiness Level (TRL) is formally signed off by the supplier and handed to the mine for approval / acceptance.
- A specific certificate of conformance will reference all the relevant information that supports that TRL.
- At every TRL a Technical File Information Audit is to be conducted as per the verification report. This

Question: What information must a CPS Technical file contain and what is delivered to the mine? Section 4

6. Scope

The content of this document applies to CPS products to be used in the SAMI for both surface and underground TMMs used by mines.

This document applies to:

- All CPS providers and SAMI employees, whose roles and responsibilities include a legal responsibility in terms of the Mine Health and Safety Act and are to ensure that this document is implemented and is being maintained.
- Any and every person who supplies an article namely: (CPS product, an element of a CPS product), constructs a structure, or supplies a hazardous chemical for the implementation or use of CPS,
 - TMM OEMs,
 - CxD developers,
 - Interface developers,
 - Third party software providers,
 - Third parties who would be contracted by SAMI to assist with CPS implementation,
 - All mines in the SAMI where CPS products are used during operation.
- The contents of the Section 21 Technical File,
- The audit / verification requirements to ensure that this document is operationalized, is periodically updated, and correctly used,

7. Reference Documents

This document is built on the following reference documents:

Applicable documents:

1. Mine Health and Safety Act No. 29 of 1996 and Regulations
2. Minerals Council Project Deliverable Section 21 File Analysis Report
3. PART 1: User Requirements for Collision Prevention Systems,
4. Part 1: Functional Readiness Criteria for Collision Prevention Systems Development,
5. PART 2: Functional and Technical Performance Requirements for Collision Prevention Systems,
6. Test Specification for Collision Prevention Systems, and

7. Integrated CPS Testing Regime

Important reference document:

1. ISO 10 007: 2017 – Configuration Management

8. Context and application emanating from the Industry Alignment on TMM Regulations Project

The Industry Alignment on TMM Regulations Special Project from the Minerals Council South Africa has been initiated to accelerate the readiness of CPS Products for use in the mining industry.

8.1 Systems Engineering Approach and Applicable Documents application

The accelerated CPS development initiative is structured on an applied Systems Engineering approach, incorporating the Technology Readiness Level Framework, and therefore is used as a framework for Applicable Documents 4, 6 and 7 above.

Applicable Documents 4 and 5 set out the **minimum** requirements that a CPS product must conform to, whilst Applicable Documents 6 and 7 specify the requirements for testing. Applicable Document 3 defines the formal User (mine/business) Requirements for CPS Systems.

8.2 Systems Engineering Themes

Most of the Applicable Documents are structured such that the specific requirements and criteria that are applicable to a **specific sub** system (see figure 1) can be easily identified. Inevitably, this results in the duplication of most of the requirements and criteria for a CxD and a TMM CPS product. Applicable Document 4 provides a brief description of the primary activities to be undertaken by the developer and the information to be generated.

To provide a more holistic overview of the aspects to be addressed in the Section 21 Technical File (although it must cover all the elements), the following Systems Engineering related themes are to be covered:

- CPS System Identification.
- SAMI requirements analysis.
- Legal Liability assessment(s).
- TMM OEM specification sheets.
- **Quality and Development Management**
 - Quality, design, and development standards (Hardware and Software).
 - Quality Plans,
 - Conformance management.

- Design for Safety.
- Verification and Validation.
 - Simulation,
 - Software verification, validation, and stress testing,
 - Physical Verification,
 - Development Testing,
 - Independent Testing,
 - Validation plan.
- Supply and Manufacturing.
- Configuration and Change Management,
 - Information Tree(s).
 - Document and information register(s).
 - Version Control.
- Project Management.
- Functional Analysis, requirements allocation, product breakdown structure(s).
- Trade-off Studies.
- Design for self-diagnostics.
- Interface management.
- Standardisation Studies.
- Maintainability Studies.
- Requirements Specification:
 - Functional, Technical, Physical, Manufacturing, Factory Acceptance,
 - Operational:
 - Operator,
 - Maintenance.
 - Manufacturing and installation Drawings.
 - Bills of materials.
 - Data sheets.
 - Check sheets.
- Risk Assessment:

- Industry Collision Risk studies.
- HAZOP and Vulnerability studies.
- FMECA studies.
- Reliability studies.
- Fail to Safe assessments.
- Functional Safety assessments.
- Safety of the intended function assessments.
- Unintended consequence and human factors analysis.
- Electromagnetic interference assessment.
- Independent Functional Verification:
 - TRL 4,6 and 7.
- On-mine operational verification:
 - TRL 8.
- On-mine operational validation:
 - TRL9.

Any CPS product developer/provider that are certified or follows the principles and processes of ISO 15288 and ISO 9001 will readily identify the correlation between the listed Systems Engineering themes and the ISO standards content. The minimum requirements should therefore not pose any challenge for CPS product developers/providers and CPS product providers will most likely have additional information to be included in their product Technical Files as required by their companies' management systems.

8.3 CPS System Scope

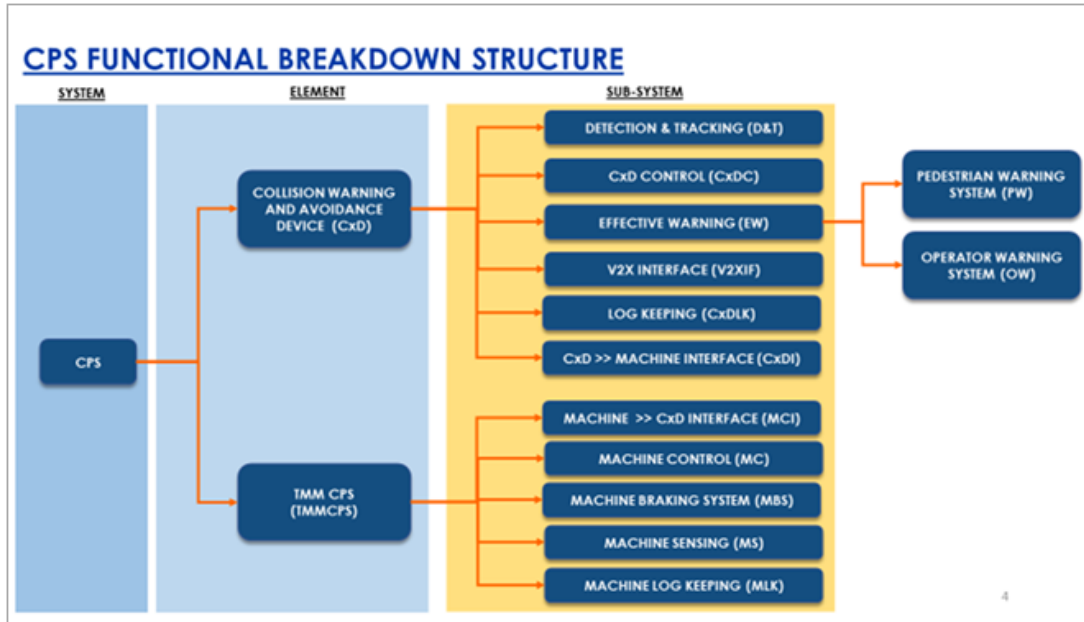


Figure 1: CPS Functional Breakdown Structure

Figure 1 provides a graphical depiction of a CPS functional system. It is fully explained in Applicable Document no 5. It is shown here for context and reference only.

Figure 2 depicts the CPS development and verification process flow. Figures 3 and 4 depicts the details of TRL 1-4 for the CxD and TMM CPS respectively. These figures are described in detail in Applicable Documents 4 and 7 and are shown here for reference only.

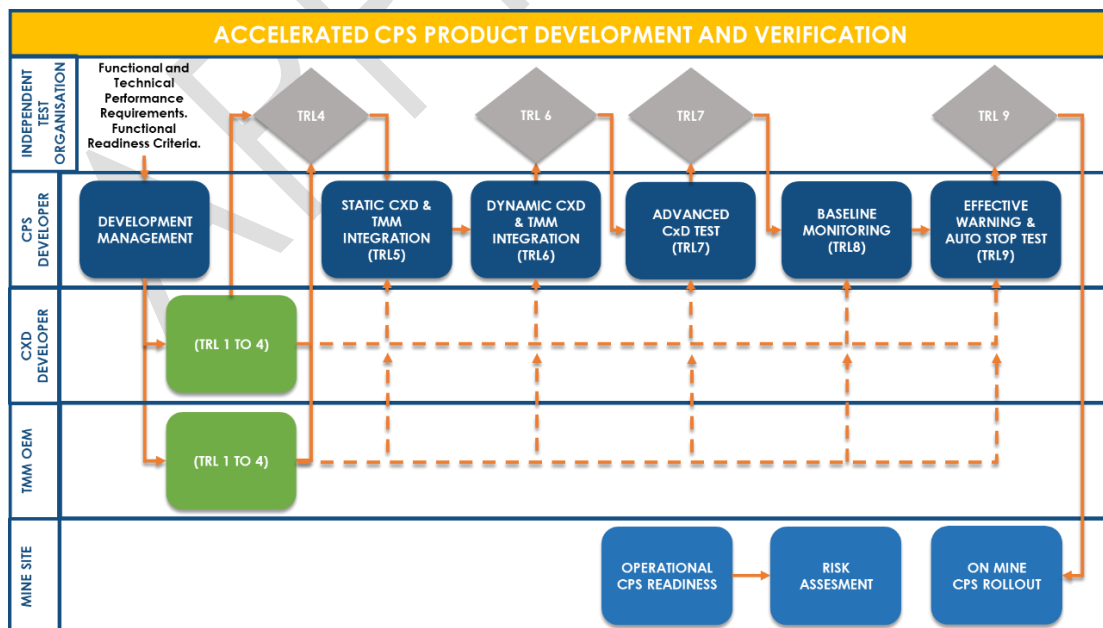


Figure 1: CxD TRL 1 to TRL 4 Process Flow

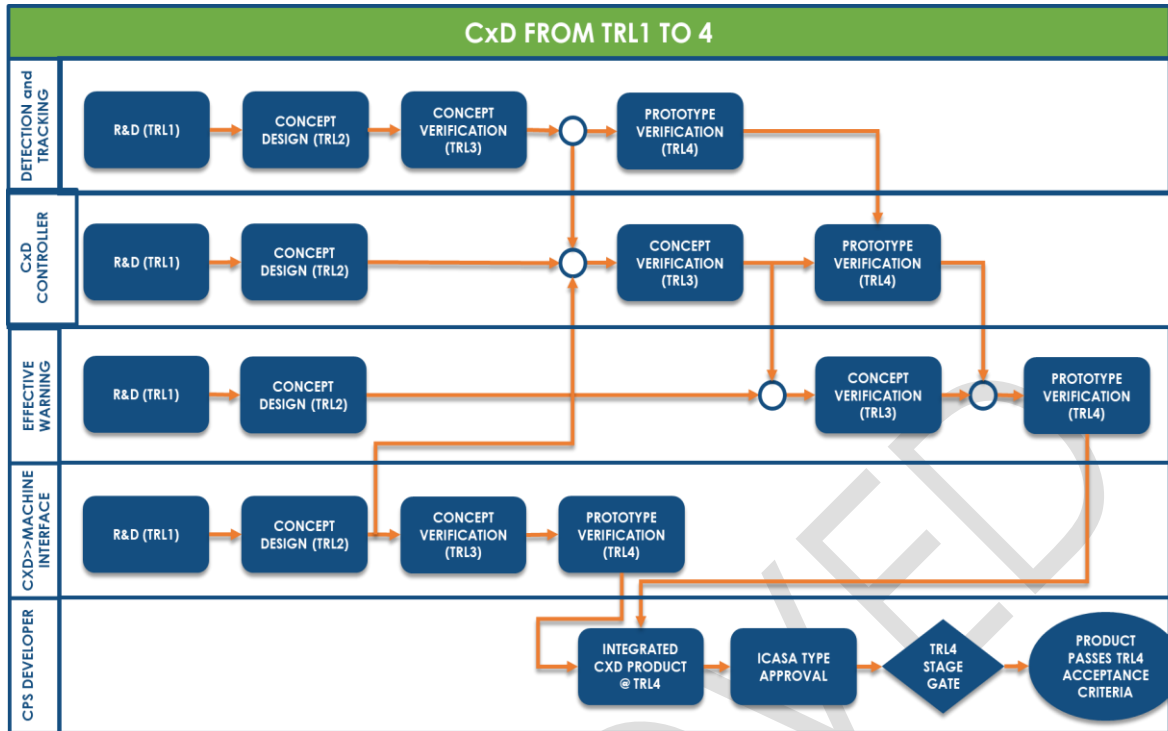


Figure 2: CxD TRL 1-4 process flow

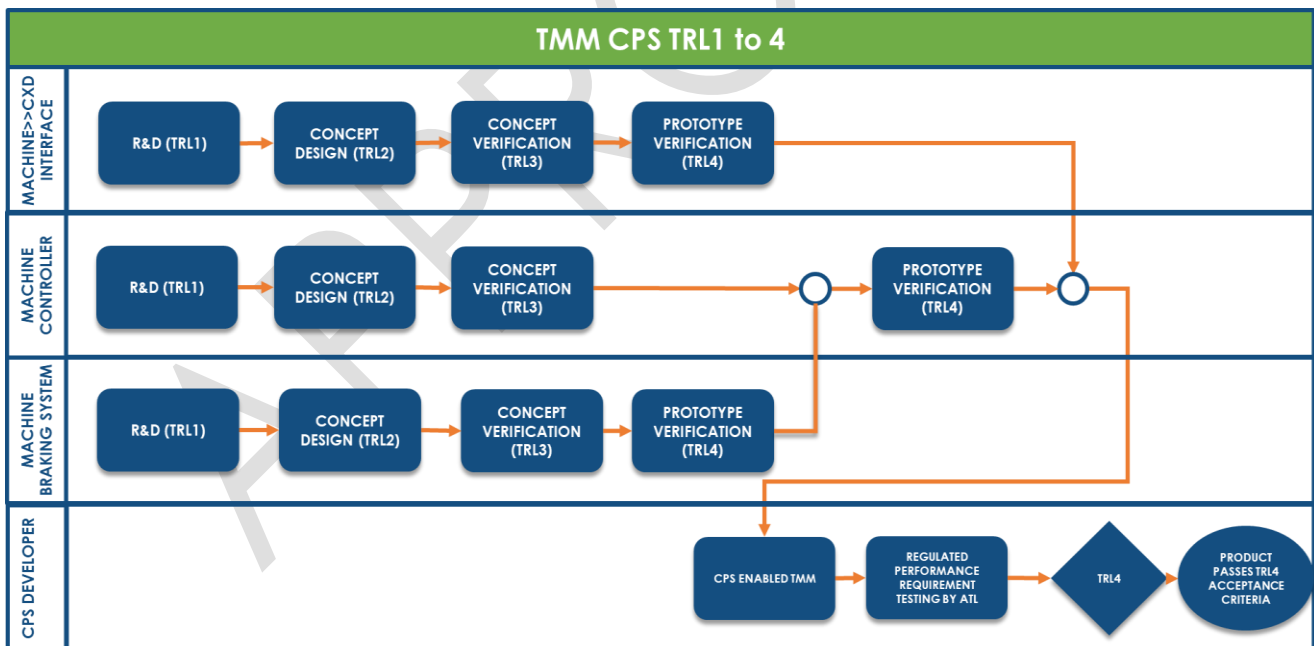


Figure 3: TMM CPS TRL 1 to TRL 4 Process Flow

9. Information Compilation Process

The information to be included in a CPS product Technical File should all be generated in the normal course of product development, verification, and validation. The processes below (Figures 5, 6 and 7) define the steps proposed to systematically generate, store, and compile a CPS Technical File. Where such a process has not/is not followed the information will have to be compiled after the fact.

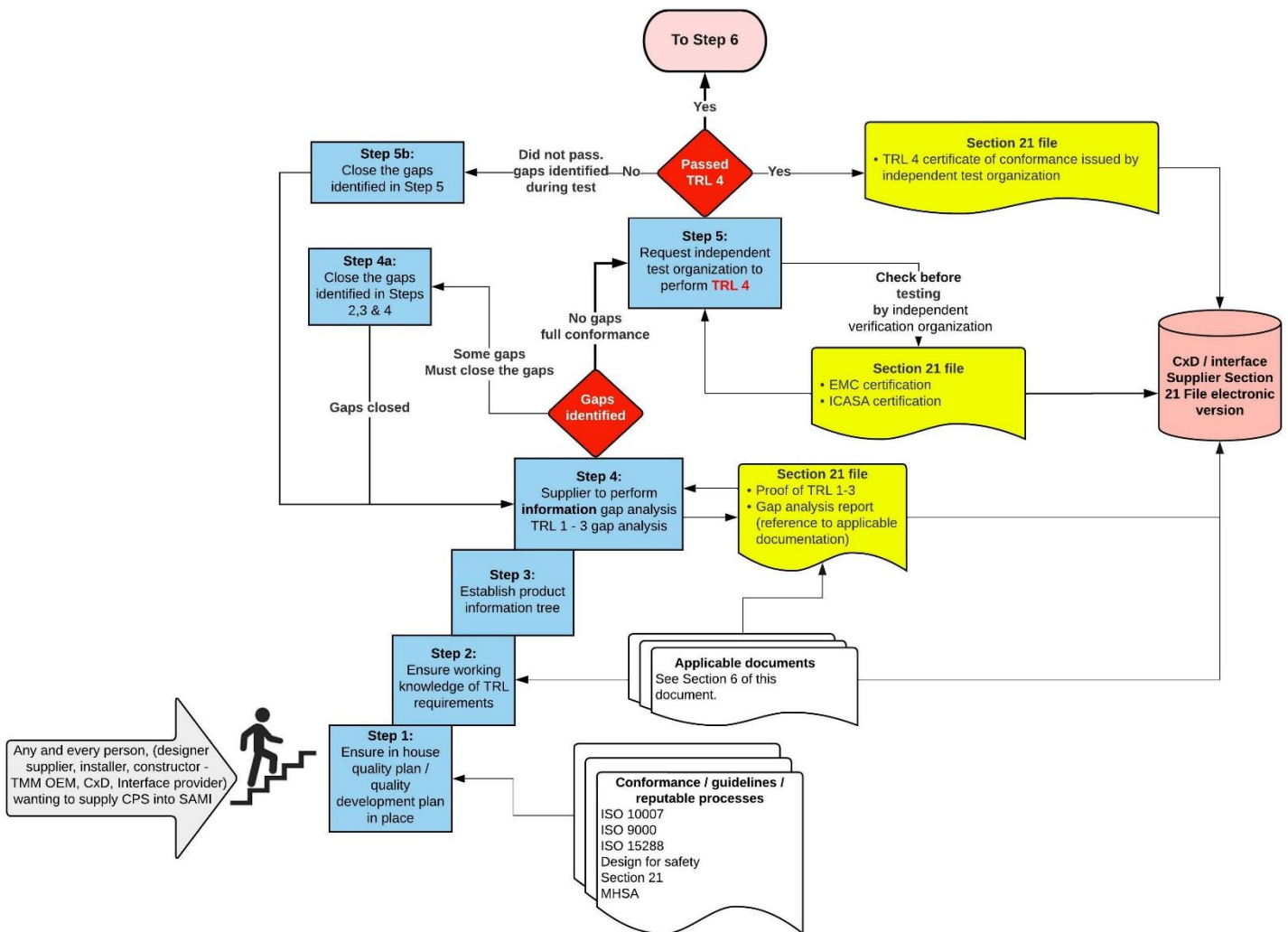


Figure 4: CxD / interface supplier TRL 1 to TRL 4 Process Flow Steps for information

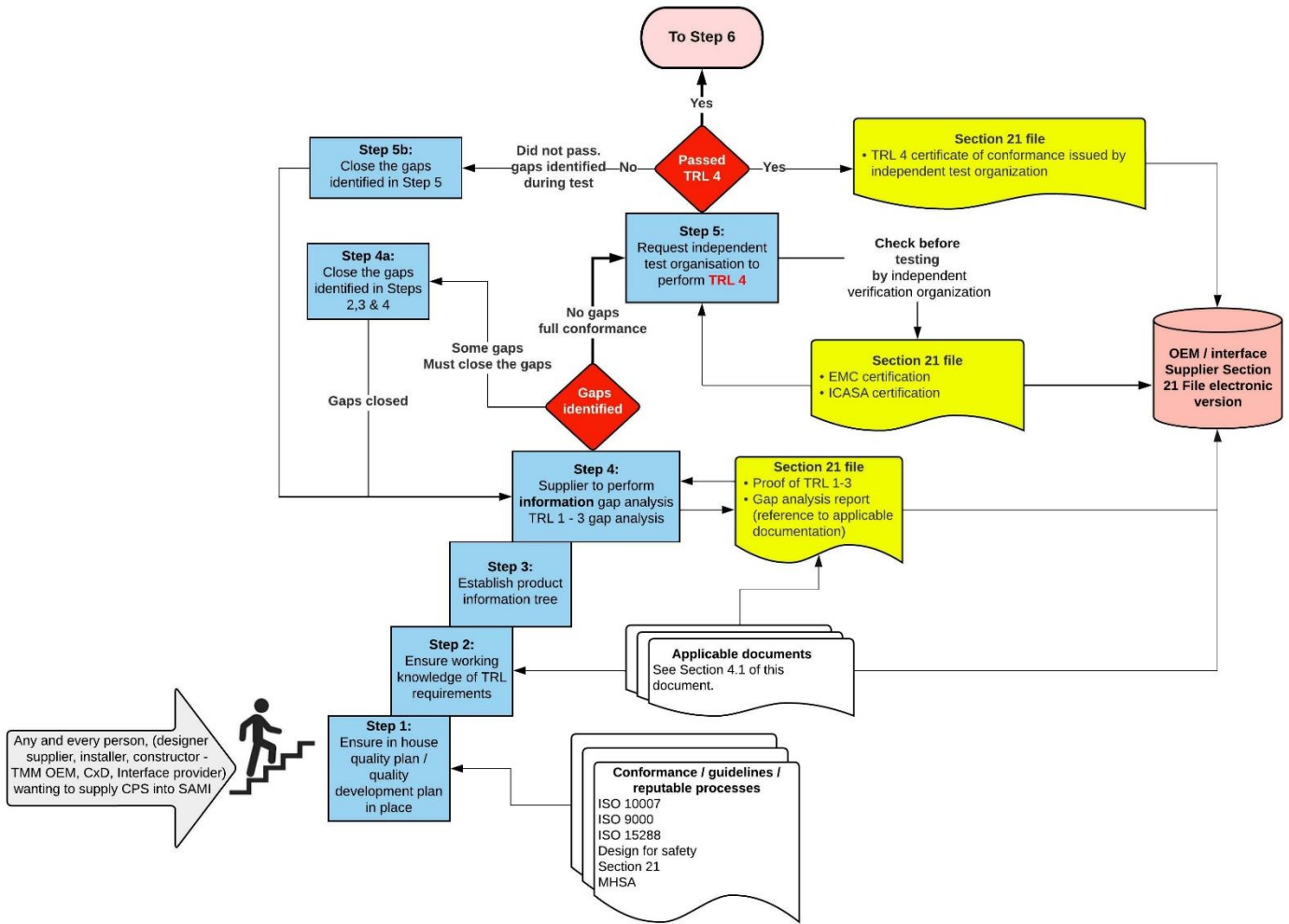


Figure 5: OEM / Interface Supplier TRL 1 to TRL 4 Process Flow Steps for information

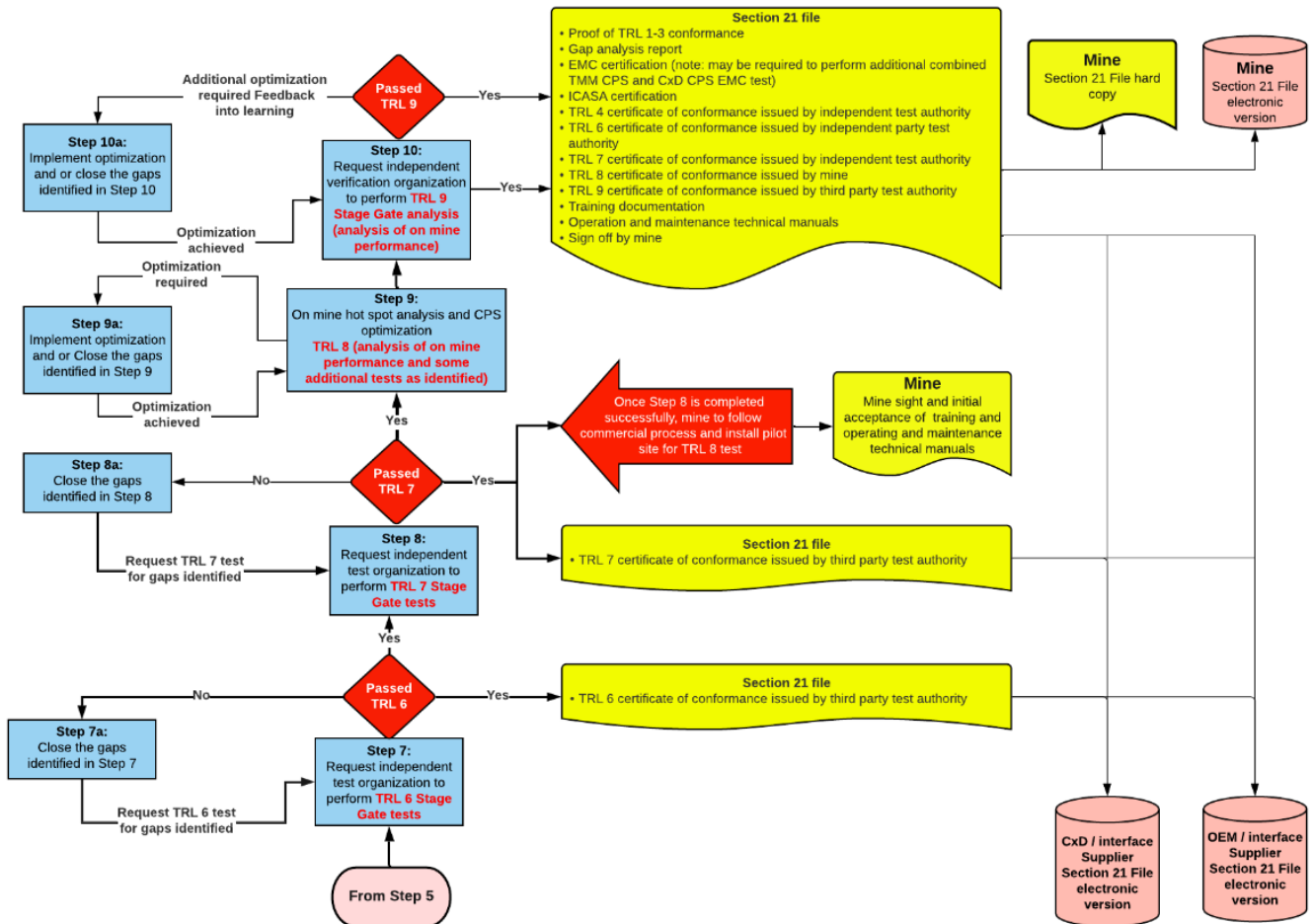


Figure 6: CPS / Mine TRL 6 – 9 Process Flow Steps for information compilation of Section 21 File

10. CPS Section 21 Technical File – Principles, Roles, and Responsibilities

Compilation of the CPS Section 21 information is a multi-organisational task that will, as a minimum, include the CxD product provider and the TMM OEM. Other parties that may be involved in the compilation are:

- Interface technology provider,
- Third party information technology providers etc.
- Additional third-party suppliers

10.1 Section 21 information Principles

The principles for generating, storing, and maintaining CPS Section 21 information are contained in ISO 10 007: 2017 – Configuration Management and the information as follows:

- All base information must be generated by the relevant organisation holding the legal liability for the CPS product, element, or subsystem that it supplies
- All base information must be kept in at least two separate central electronic locations i.e., server and cloud or multiple servers. One of the locations must be fireproof.
- The legal entity owning the information must keep an Information Register (IR) of all relevant information. The minimum data in the IR must be as follows:
 - Unique identifier – number for every information set (document),
 - Title,
 - Type of information,
 - Revision of information,
 - Status of information,
 - Date of generation,
 - Date of approval,
 - Date of independent review if done,
 - Electronic File name(s) and formats,
 - Primary storage location,
 - Secondary storage location.
- All base information must be:
 - Uniquely identified – i.e., given a title and number,
 - Assigned a revision and date of the revision,

- Assigned a status D= Draft, A=Approved, IR = Independently Reviewed,
- Date stamped against each status,
- Assigned a type identifier.
- Where information was independently (separate legal entity) generated or verified, the verifier's detail must be recorded for traceability purposes.
- At every TRL a Certificate of Conformance (CoC) must be generated referencing the relevant base information unique identifier, title, revision and if the base information was independently verified.
- Certificates of Conformance must be signed by the legal entity Quality Assurance Manager
- The following base information must as a minimum be independently verified by a credible independent organisation:
 - Product, element, and sub system risk assessments
 - Functional Tests Results (TRL 4,6,7)
 - FMEA/FMECAs
 - HAZOPs
 - Physical Integration Verification
 - Human factors design analysis
 - Maintainability Analysis
 - TRL Information Audits

10.2 CPS developer Roles and Responsibilities

The primary role of the CPS developer is CxD and TMM CPS integration. The CPS Developer is therefore also responsible to ensure the generation and collation of the Technical File information as defined in Figure 7 above.

10.3 TMM OEM Roles and Responsibilities

If the TMM CPS product or elements are supplied by the TMM OEM, it is the OEM's responsibility to compile the relevant Technical File information and submit it for verification as per its own verification plan. Minimum independent verification required is as stated in Section 10 of this document.

Key information to be compiled by the TMM OEM is the TMM CPS Specification Sheet. The sheet can be in the format as decided by each TMM OEM. The data on the sheet however must unambiguously define conditions, constraints, and limitations from the specific TMM that the CxD developer must incorporate into the design of the CxD product.

It is also the responsibility of the OEM to enable an effective change management process for any changes to the OEM CPS, thereby ensuring that the Section 21 file is “change informed” and updated accordingly.

It is the OEM's responsibility to inform the mine(s) of changes and re-issue the relevant CoC(s) and submit it for acceptance by the mine(s) to update its signed off Section 21 file.

10.4 CxD developer Roles and Responsibilities

If the CxD product or elements are supplied by the CxD provider, it is the CxD developer's responsibility to compile the relevant Technical File information and submit it for verification as per its own verification plan. Minimum independent verification required is as stated in Annexure 2.

It is also the responsibility of the CxD developer to enable an effective change management process for any changes to the CxD, thereby ensuring that the Section 21 file is “change informed” and updated accordingly.

It is the CxD developer/provider's responsibility to inform the mine(s) of changes and re-issue the relevant CoC(s) and submit it for acceptance by the mine(s) for the mine to update its signed off Section 21 file.

10.5 Interface provider Roles and Responsibilities

In cases where the TMM OEM outsources TMM CPS development and supply to a 3rd-party / interface provider, three parties are part and parcel of the CPS solution, namely the TMM OEM, the CxD provider, and the Interface Provider.

It is the 3rd -party TMM CPS developer's responsibility to compile the relevant Technical File information and submit it for verification as per its own verification plan. Minimum independent verification required is as stated in section 10 of this document.

It is also the responsibility of the 3rd -party TMM CPS developer to enable an effective change management process for any changes to the TMM CPS thereby ensuring that the Section 21 file is “change informed” and updated accordingly.

It is the Interface developer/provider's responsibility to inform the mine(s) of changes and re-issue the relevant CoC(s) and submit it for acceptance by the mine(s) for the mine to update its signed off Section 21 file.

10.6 Software integrator Roles and Responsibilities

Most CPS solutions will require software and hardware installation on a mining site. The software provider may be different to the OEM, CxD supplier or interface provider (example: Lamp room technology and pedestrian tracking, etc.) In this case, it is the software integrator's responsibility to complete the

software integration compliance Section 21 file and submit it for verification at the appropriate TRL Stage Gate.)

It is also the responsibility of the Software integrator to enable an effective change management process for any changes to the Software integrator's CPS thereby ensuring that the Section 21 file is "change informed" and updated accordingly.

It is the Software Integrator's responsibility to inform the mine of these changes and submit these changes for the mine to include in their signed off Section 21 file.

10.7 Independent verification and/or test entity Roles and Responsibilities

For activities and information that requires independent verification, the verification entity must be provided with the necessary contexts and requirements for verification. For independent testing, it is the third-party testing authority's responsibility to verify that the prerequisite information and independent verification have been completed before starting the testing.

It is also the third-party testing authority's responsibility to write a report after testing at each stage gate. These reports are key parts of demonstrating conformance and are also to be included the Section 21 file information.

Note: third-party testing authorities may include but are not limited to:

- Persons performing the stage gate tests,
- Persons performing the EMC tests,
- Person issuing the ICASA licenses.

10.8 Mine Roles and Responsibilities

It is the mine's responsibility to:

- review the Section 21 File information (Certificates of Conformance) provided by the CPS supplier,
- ensure the file is complete,
- sign off the file,
- ensure the ongoing accuracy of the file (audit),
- ensure the proper file (documentation) change management and storage processes are in place for easy retrieval, Section 21 compliance, and reference purposes.

11. Annexure 1 – Section 21 Technical File Content Structure

SECTION 21 Technical File
For the
CxD provider “A” Product “AA₁” – OEM “B” TMM Type
“BB₁”
Surface TMM CPS System
For
Mine “MM”

APPROVED

Table of contents

Include Table of Contents here as specified in sections below:

Purpose of CPS Section 21 information

The MHS Act Section 21 requires any person that provides a CPS product to the SAMI to ensure that reasonably practicable measures are taken to ensure that CPS products are free from health and safety risk for persons when the CPS is used as intended. The information provided and/or referenced herein comprises the portfolio of evidence of the reasonably practicable measures taken for the CPS System to comply with Section 21 of the MHSA.

Definitions and abbreviations

The following definitions and abbreviations were used in this document.

Note: The CPS providers to correct/complete this section.

Article	<p>A CPS, its elements or any sub systems as defined in the CPS functional breakdown structure, that can pose a health or safety risk to employees including, but not limited to:</p> <ul style="list-style-type: none"> • TMM CPS, and • CxD, <p>Note 1: see Figure 1 for the CPS functional breakdown structure.</p> <p>Note 2: see Figure 2 for further definition of "any, an, and the article".</p>
Any or every person	<p>Means any person (including employee or contractor) or supplier who supplies, designs, manufactures, constructs, or installs any article or structure, or supplies hazardous substances to SAMI.</p> <p>Note 1: Any is a random pick of one or a few.</p> <p>Note 2: Every includes all of a set or group.</p> <p>Note 3: Any and every member of a group means all the members of that group.</p>
CoC	<p>Certificate of Conformance or Conformity. Is a document issued by any person with such authority within the supply organisation to confirm that the product has been manufactured with test results showing conformance to the reference documents (applicable documents) specified in this document.</p>

Configuration Management	<p>Configuration management (CM) is the field of management focused on establishing and maintaining the consistency of its system or product performance and its functional and physical attributes. The system and product requirements, design, and operational information documentation must be maintained and available throughout its life.</p> <p>Through the control of changes the configuration process manages the security features and assurances throughout the life cycle of an information system to hardware, software, firmware, documentation, test, test fixtures, and test documentation</p>
CPS	<p>Collision Prevention System: A Product System that comprises the functionality and characteristics that comply with the RSA TMM collision prevention regulations. (TMM Regulations 8.10.1 and 8.10.2 and user requirements.) See Figure 1 for the CPS functional breakdown structure.</p>
CPS product provider	<p>Any person supplying or providing any element or sub system in the CPS.</p>
CPS Developer	<p>The single integration organisation as agreed between all providers (persons) providing a specific CPS product i.e. A CxD, a TMM CPS and or an interface technology.</p>
CWAS/(CxD)	<p>Collision Warning and Avoidance System device (CxD): Device with sensors providing collision warning and avoidance functions, to detect objects in the vicinity of the machine, assess the collision risk level, effectively warn the operator of the presence of object(s) and/or provide signals to the machine control system, to initiate the appropriate interventional collision avoidance action on the machine, to prevent the collision.</p> <p>Note to entry: Proximity Detection System (PDS) is a colloquial industry term for a physical device, providing a warning or collision avoidance functionality.</p>
CxD	<p>Collision warning/detection/management Device.</p>
DMRE	<p>Department of Mineral Resources and Energy.</p>
EMC	<p>Electromagnetic Compatibility</p>
EMI	<p>Electromagnetic Interference</p>
EMESRT	<p>Earth Moving Equipment Safety Round Table</p>
Employee	<p>Employee means any person who is employed or working at a mine.</p>

Functional Specification	Specifications that define the function, duty, or role of the product/system. Functional specifications define the task or desired result, by focusing on what is to be achieved, rather than how it is to be done.
F	Function: Indicates a function of the CPS or functional group.
FMECA	Failure Mode Effect and Criticality Analysis
FTS	Fail to Safe: The functionality that will bring a TMM to a controlled stop
G	General: Indicates a general requirement that is applicable to the entire CPS and all of its elements, modules, and components.
ICASA	<i>Independent Communications Authority of South Africa</i>
ICMM	International Council on Mining and Metals.
ID	Identifier.
Independent	Separate from the CPS product developer. Note: Independent does not imply an accredited 3 rd party, although where required by local or international standards, it includes accredited 3 rd parties.
Independent person	A person, typically a test-, software- or EM engineer, who is not affiliated with the CPS provider or TMM OEM, that can provide an unbiased assessment.
Interface	A boundary across which two independent systems meet and act on/or communicate with each other notably: examples: 1. CxD-machine interface – The interface between a Collision Warning and Avoidance System Device (CxD) and the machine. This interface is described in ISO/DTS21815-2. 2. Note: An interface implies that two separate parties (independent systems), are interacting with each other, which may present interoperability and/or EMI and EMC challenges.
Minerals Council	Minerals Council South Africa.
MHS Act	Mine Health and Safety Act No. 29 of 1996 and Regulations.
MHSC	Mine Health and Safety Council.
PDS	Proximity Detection System – see CxD.
Pedestrian	A person lying, sitting, or walking rather than travelling in a vehicle.

Project	Industry Alignment on TMM Collision Management Systems Project: CAS READINESS PHASE.
PWS	Pedestrian warning System: The system that provides the effective warning to pedestrians.
Quality Assurance	Verifying a process, product, or service; usually conducted by an experienced person in the specific field.
Reasonably practicable measure	Reasonably practicable means practicable with regards to: (a) The severity and scope of the hazard, or risk concerned. (b) The state of knowledge reasonably available, concerning the hazard or risk, and of any means of removing or mitigating the hazard or risk. (c) The availability and suitability of means to remove or mitigate that hazard or risk, and (d) The costs and the benefits of removing or mitigating that hazard or risk.
SAMI	South African Mining Industry.
System	A combination of interacting elements organized to achieve one or more stated purposes (ISO/IEC/IEEE 2015).
T	Technical: Indicates a technical requirement of the CPS or functional group.
Technical specification	Specifications that define the technical and physical characteristics and/or measurements of a product, such as physical aspects (e.g., dimensions, colour, and surface finish), design details, material properties, energy requirements, processes, maintenance requirements and operational requirements.
Stage gate	A step in the testing regime / process where the CPS product system is tested against acceptance criteria, the failure of which would limit the CPS product system from moving to the next step in the regime / process.
This document	MHSA Section 21 file for CPS – Information framework.

TMM	<p>Trackless Mobile Machine. (Machine, vehicle, etc.)</p> <p>Trackless Mobile Machine means any self-propelled mobile machine that is used for the purpose of performing mining, transport or associated operations underground or on surface at a mine and is mobile by virtue of its movement on wheels, skids, tracks, mechanical shoes or any other device fitted to the machine, but excludes :</p> <ul style="list-style-type: none"> • Rail bound equipment; and • Scraper winches, monorail installations, static winches, winding machinery installations and any equipment attached thereto.
TMM OEM	Original Equipment Manufacturer of TMMs. Original Equipment Manufacturer of a TMM may be the organisation which originally supplied, or last rebuilt, or modified the TMM, or the supplier per section 21 of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).
TMM CPS	The functional group comprising all TMM CPS related functions.
TMM CPS Product	The product that will make a non-intelligent TMM intelligent and CxD ready.
TRL	Technology Readiness Level: A technology maturity framework for measuring and monitoring technology maturity in 9 increasing levels from TRL 1 to TRL 9.
3 rd Party	An entity appointed to execute work (testing, witnessing of testing and verifying portfolios of evidence) on behalf of SAMI. Note: The purpose of 3 rd party execution is to establish independence and to eliminate duplication.

Mine

This portfolio of evidence is prepared for Mine "MM" which is part of the mining group "M".

CPS System

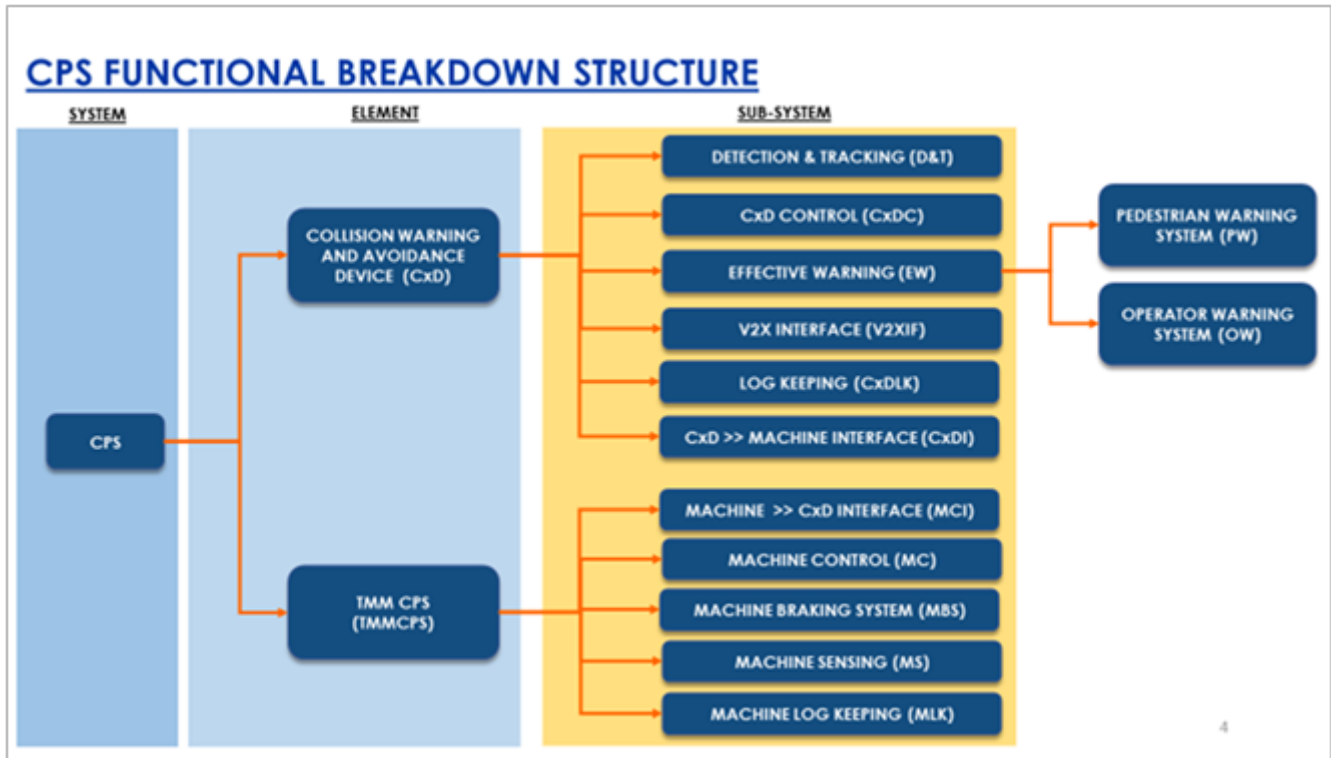


Figure 7: CPS Functional Breakdown Structure

The CPS System that this portfolio of evidence relates to is:

- CxD Provider "A" = Product "AA1".
- OEM "B" CPS = TMM Type "BB1".
- 3rd Party CPS products = ISO 21815-2:2021 interface = Interface provider "DD" - VI model 4.

CPS Products Description

- A product description of the CxD: Product "AA1" can be found on the CxD Provider "A" Website [http\www](http://www).
- A product description for OEM "B" TMM CPS Type "BB1" can be found can be found on the TMM OEM B Website [http\www](http://www).

- A product description of the Interface provider “DD” - VI model 4 interfaces can be found on the Interface provider “DD” website [http\www.](http://www.)

Legal Entities involved

- The CPS developer is OEM “B”.
- The CxD is provided by CxD Provider “A”.
- The TMM CPS is provided by a 3rd party CPS product provider “N”.
- The TMM interface is provided by Interface provider “DD”.

Definitions and abbreviations

The following definitions and abbreviations were used to collate this Section 21 information. Include definitions and abbreviations used in this document.

- CxD Information
- CxD Information Register
- Certificates of Conformance

CxD CoC:

- TRL 1 CoC
- TRL 2 CoC
- TRL 3 CoC
- TRL 4 CoC
- TRL 6 CoC
- TRL 7 CoC
- TRL 9 CoC

1. Information Verification Sheet (See Annexure 2)

1. 3rd Party CPS Information

- CxD Information Register
- Certificates of Conformance

CxD CoC

- TRL 4 CoC
- TRL 6 CoC
- TRL 7 CoC
- TRL 9 CoC

2. TMM CPS Product Information

- TMM CPS Information Register
- Certificates of Conformance

TMM CoC

- TRL 4 CoC
- TRL 6 CoC
- TRL 7 CoC
- TRL 9 CoC

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2. Annexure 2 – Section 21 Technical File Verification

Note: This sheet must be used by CxD and TMM OEM respectively and 3rd party interface supplier where relevant.

Section 21 File – Table of Contents – Checklist for Sign off						
Sec No	Section Description	Supplier Name/Designation/Date	Supplier Comments	Independent Verifier Name/Designation/Date	Independent Verifier Comments	Mine Verifier Name/Designation/Date
1	TRL 1 Information Register verification		See Verification Report no...		See Verification Report no...	
2	TRL 2 verification		See Verification Report no...		See Verification Report no...	
3	TRL 3 verification		See Verification Report no...		See Verification Report no...	
4	TRL 4 verification		See Verification Report no...		See Verification Report no...	
5	EMC compliance certification		See Verification Report no...		See Verification Report no...	
6	ICASA license and certification		See Verification Report no...		See Verification Report no...	

7	TRL 4 stage gate conformance certificate and report		See Verification Report no...		See Verification Report no...	
8	TRL 6 stage gate conformance certificate and report		See Verification Report no...		See Verification Report no...	
9	TRL 7 stage gate conformance certificate and report		See Verification Report no...		See Verification Report no...	
10	TRL 8 reports stage gate conformance certificate and report		See Verification Report no...		See Verification Report no...	
11	TRL 9 stage gate conformance certificate and report		See Verification Report no...		See Verification Report no...	
12	CPS issues-based risk assessment		See Verification Report no...			
13	CPS operating technical specification					
14	CPS maintenance technical specification (including spares)					
15	CPS operating and maintenance training					

	manual for train the trainer					
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3. Annexure 3 – Section 21 Technical File Guideline for compilation

Section number	Section Description	Inclusion in Section 21 File: Success criteria to move to next TRL level (For additional guidelines see additional guideline information)	Option 4: All testing done on mine	Inclusion in Section 21 File: Additional Guideline Information
1.0	TRL 1 verification			
1.1	Research and development complete	<p>Proof that the CPS supplier is certified and committed to effective Quality standards that provide requirements, specifications, guidelines, or characteristics that can be used consistently to ensure that materials, products, processes, and services are fit for their purpose. The minimum requirements are:</p> <ul style="list-style-type: none"> • Quality Management ISO 9000 / ISO 9001, • ISO 10007:2017: Quality management — Guidelines for configuration management, • Auditing ISO 19011, • Risk Management ISO 31011 • Project management: PMBOK 	As per success criteria	<ul style="list-style-type: none"> • SAMI CPS Requirements Analysis <ul style="list-style-type: none"> - Legal Liability assessment(s) - OEM Spec sheets • Quality and Development Management <ul style="list-style-type: none"> - Quality, design and development standards (Hardware and Software) - Quality Plan(s) - Conformance management - Design for Safety • Verification and Validation <ul style="list-style-type: none"> - Simulation - Validation plan - Configuration and Change

1.2	<p>Vicinity Detection Module requirements defined, basic principles observed and reported</p>	<ul style="list-style-type: none"> • Signed off plans. • TMM OEM agreements, • TMM characteristics available and signed off by TMM OEM • VD based on peer reviewed approaches. Target operational environment & equipment identified (surface vs. UG or both). Functional analysis completed. Concepts ready to be evaluated and selected based on functional analysis. 	As per success criteria	<p>Management</p> <ul style="list-style-type: none"> - Information Trees - Master Record Index(s) - Version Control - Project Management - Functional Analysis, requirements allocation, product breakdown structure(s) - Trade off Studies - Standardisation Studies - Requirements Specification • Risk Assessment - Industry Collision Risk studies - Unintended consequence and human factors analysis
2.0 TRL 2 Verification				
2.1	Concept Design complete			
2.1.1	<p>Vicinity Detection design concept and application formulated. (1st Gen or Mock-up)</p>	<ul style="list-style-type: none"> • All design and analysis documented for traceability, as per project quality plan. • FMECA completed 	As per success criteria	<ul style="list-style-type: none"> • Verification and Validation - Software verification, validation and stress testing - Functional Analysis, requirements allocation, product breakdown structure(s) - Trade off Studies - Design for self-diagnostics

			<p style="text-align: center; opacity: 0.3; font-size: 48px; transform: rotate(-30deg);">APPROVED</p>	<ul style="list-style-type: none"> - Interface management - Standardisation Studies - Maintainability Studies - Requirements Specification - Functional, Technical, Physical, Manufacturing, Factory Acceptance • Operational Manuals <ul style="list-style-type: none"> - Operator - Maintenance - Manufacturing and installation Drawings - Bills of materials - Data sheets - Check sheets • Risk Assessment <ul style="list-style-type: none"> - HAZOP and Vulnerability studies - FMECA studies - Reliability studies - Fail to Safe assessments - Functional Safety assessments - Unintended consequence and human factors analysis
3.0	TRL 3 verification			
3.1	Concept verification complete			

<p>3.1.1</p>	<p>Vicinity Detection proof of concept. Next Gen item manufactured / sourced, assembled, FAT. (Breadboard)</p>	<ul style="list-style-type: none"> • All design and analysis documented for traceability, as per project quality plan. • Certificate of conformance issued by module developer 	<p>As per success criteria</p>	<ul style="list-style-type: none"> • Verification and Validation <ul style="list-style-type: none"> - Software verification, validation and stress testing - Physical Verification - Development Testing - Manufacturing - Design for self-diagnostics - Maintainability Studies - Functional, Technical, Physical, Manufacturing, Factory Acceptance • Operational Manuals <ul style="list-style-type: none"> - Operator - Maintenance - Manufacturing and installation Drawings - Bills of materials - Data sheets - Check sheets • Risk Assessment <ul style="list-style-type: none"> - HAZOP and Vulnerability studies - FMECA studies - Reliability studies - Fail to Safe assessments - Functional Safety assessments
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				- Electromagnetic interference assessment
4.0	TRL 4 - verification for entry			
4.1	EMC compliance certification	IEC/SANS safety test report	As per success criteria	<ul style="list-style-type: none"> • Verification and Validation - Physical Verification - Development Testing - Independent Testing - Manufacturing • Operational Manuals - Operator - Maintenance - Manufacturing and installation Drawings - Bills of materials - Check sheets • Risk Assessment - Electromagnetic interference assessment
4.2	ICASA license and certification	Radio equipment type approval certificate	As per success criteria	
4.1	TRL 4	Certificate of conformance issued by third party testing authority - Stage Gate	Independent verification	
4.1.1	Vicinity Detection Functional Validation. Next generation item manufacturing, assembly, and FAT			

4.1.1.1	(Validation in workshop/lab environment to verify fit, form and function)	<p>Certificate of conformance issued by third party testing authority for:</p> <ul style="list-style-type: none"> • Adherence to inhouse design and development processes. • Test and verification results. • OEM signoff for “On TMM” testing to commence. (Positional and electrical wiring diagrams approved by TMM OEM and CxD supplier) 	<ul style="list-style-type: none"> • Certificate of conformance issued by independent test authority which may be independent test authority or mine quality assurance • OEM and 2.13.1 mine engineer to sign a drawing or certificate of acceptance for CxD placement and interface on TMM. 	
4.1.1.2	Stage Gate test: TMM / Machine to CxD ISO/TS 21815-2:2021 bench test by third party testing authority	<p>Certificate of conformance to ISO 21815-2: 2021: As specified in Test Specification for Collision Prevention Systems, Appendix 1, subdivision 6</p>	Certificate of conformance issued by independent test authority	
4.1.1.3	TMM ISO21815 Bench test: TMM Log keeping test protocol (MLK, MCI) bench test by third party testing authority	<p>Certificate of conformance to ISO 21815-2: 2021: As specified in Test Specification for Collision Prevention Systems, Appendix 2, subdivision 6</p>	Certificate of conformance issued by independent test authority	
4.1.1.4	TMM FTS and Machine response: Machine sensing test protocol (MS, MC, MCI, MLK) – On machine test by	<p>Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 3, subdivision 6</p>	Certificate of conformance issued by independent test authority	

	third party testing authority			
4.1.1.5	TMM FTS and Machine response: TMM Self-diagnostics (MC, MCI, and MLK). On machine test by third party testing authority	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 4, subdivision 6	Certificate of conformance issued by independent test authority	
4.1.1.6	TMM FTS and Machine response: TMM Machine controller Surface response (MC). On machine test by third party testing authority	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 5, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test may be conducted at OEM test facility or on mine. • Certificate of conformance issued by independent test authority, OEM or mine 2.13.1 appointee 	

4.1.1.7	TMM FTS and Machine response: TMM Machine controller UG response (MC). On machine test by third party testing authority	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 6, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test may be conducted at OEM test facility or on mine. • Certificate of conformance issued by independent test authority, OEM or mine 2.13.1 appointee 	
4.1.1.8	CxD ISO21815 Bench test. CxD ISO/TS21815-2:2021 test protocol (MCI). Bench test by third party testing authority	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 7, subdivision 6	As per success criteria	
4.1.1.9	CxD ISO21815 Bench test. CxD Log Keeping test protocol (CxDLK, CxDI)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 8, subdivision 6	As per success criteria	

4.1.1.10	CxD Interaction scenario: Self-diagnostics (CxDC, CxDI, CxDLK, D&T, OWS)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 9, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test may be conducted at OEM test facility or on mine. • Certificate of conformance issued by independent test authority, OEM or mine 2.13.1 appointee 	
4.1.1.11	CxD Interaction scenario: Self-diagnostics Underground test protocol (CxDC, CxDI, CxDLK, D&T, OWS and PWS)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 10, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test may be conducted at OEM test facility or on mine. • Certificate of conformance issued by independent test authority, OEM or mine 2.13.1 appointee 	
4.1.1.12	CxD Interactive scenario: Effective warning Surface test protocol (OWS)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 11, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. 	

4.1.1.13	CxD Interactive scenario (UG) Effective Warning Underground test protocol (OWS & PWS)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 12, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. 	
4.1.1.14	CxD Interactive scenario stage gate. CxD Basic detection and tracking Surface test protocol (D&T)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 13, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. 	
4.1.1.15	CxD Interactive scenario: CxD Basic detection and tracking Underground test protocol (D&T)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 14, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. • Test witnessed by OEM, CxD (and interface technology provider) and mine QA. Signed by all parties 	

4.1.1.16	CxD Interactive scenario: CxDC Surface logic test protocol (CxDC)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 15, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. • Test witnessed by OEM, CxD (and interface technology provider) and mine QA. Signed by all parties 	
4.1.1.17	CxD Interactive scenario: CxDC UG logic test protocol (CxDC)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 16, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. • Test witnessed by OEM, CxD (and interface technology provider) and mine QA. Signed by all parties 	
4.1.1.18	CxD Detection robustness: CxD UG Detection robustness test protocol (D&T)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 17, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance 	

			issued by mine 2.13.1 appointee or independent test authority. • Test witnessed by OEM, CxD (and interface technology provider) and mine QA. Signed by all parties	
6	TRL 6 verification (Stage Gate)	Certificate of conformance issued by third party testing authority	Independent verification	Inclusion in Section 21 File: Additional Guideline Information
6.1	CPS systems integration stage gate CPS Surface systems integration protocol (CxD + TMM)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 18, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. • Test witnessed by OEM, CxD (and interface technology provider) and mine QA. Signed by all parties 	<ul style="list-style-type: none"> • Verification and Validation <ul style="list-style-type: none"> - Physical Verification - Development Testing - Manufacturing • Operational Manuals <ul style="list-style-type: none"> - Operator - Maintenance - Manufacturing and installation Drawings - Bills of materials - Check sheets
6.2	CPS systems integration CPS UG systems integration protocol (CxD + TMM)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 19, subdivision 6	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. • Test witnessed by OEM, CxD (and 	

			interface technology provider) and mine QA. Signed by all parties	
7	TRL 7 verification (Stage Gate)	Certificate of conformance issued by third party testing authority	Independent verification	Inclusion in Section 21 File: Additional Guideline Information
7.1	Pilot site interaction (surface): CxD Surface pilot site test protocol (CxD + TMM)	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 20, subdivision 17	<ul style="list-style-type: none"> • Gap analysis: Mine to perform gap analysis to determine test requirements against MC gap analysis methodology. • Test conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. • Test witnessed by OEM, CxD (and interface technology provider) and mine QA. Signed by all parties 	<ul style="list-style-type: none"> • Verification and Validation <ul style="list-style-type: none"> - Independent Testing - Manufacturing
8	TRL 8 verification (Stage Gate)	Certificate of conformance issued by third party testing authority	Independent verification	Inclusion in Section 21 File: Additional Guideline Information

8.1	On site verification with partial CPS enablement	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 21, subdivision 5	<ul style="list-style-type: none"> • Test to be conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. • Test (hot spot analysis) witnessed by OEM, CxD (and interface technology provider) and mine QA. Signed by all parties 	<ul style="list-style-type: none"> • Verification and Validation - Manufacturing
8.2	On site verification with partial CPS enablement	Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 22, subdivision 11	<ul style="list-style-type: none"> • Test to be conducted on mine. • Certificate of conformance issued by mine 2.13.1 appointee or independent test authority. • Test (hot spot analysis) witnessed by OEM, CxD (and interface technology provider) and mine QA. Signed by all parties 	
9	TRL 9 verification (Stage Gate)	Certificate of conformance issued by third party testing authority	Independent verification	Inclusion in Section 21 File: Additional Guideline Information

9.1	CPS Validation Surface	<p>Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 23, subdivision 3</p>	<p>Two scenarios:</p> <ul style="list-style-type: none"> • On mine interaction analysis (hot spot) done by mine 2.13.1 appointee or independent third party witnessed and signed off by CxD provider and OEM. Sign off by 2.13.1 appointee (and mine QA), CxD provider and OEM. • Should mine 2.13.1 or mine risk assessment require independent third party to perform analysis and sign off, the independent third party to perform work and issue certificate of conformance. 	<ul style="list-style-type: none"> • Verification and Validation <ul style="list-style-type: none"> - Independent Testing - Manufacturing
9.2	CPS Validation Underground	<p>Certificate of conformance: As specified in Test Specification for Collision Prevention Systems, Appendix 24, subdivision 4</p>	<p>Two scenarios:</p> <ul style="list-style-type: none"> • On mine interaction analysis (hot spot) done by mine 2.13.1 appointee or independent third party witnessed and signed off by CxD provider and OEM. Sign off by 2.13.1 appointee (and mine QA), CxD provider and OEM. • Should mine 2.13.1 or mine risk assessment require independent third party to perform analysis and sign off, the independent third party to perform work and issue certificate of conformance. 	

10	CPS issues-based risk assessment	If there are no other means (controls) to mitigate a risk that will pose an unacceptable risk to the health and safety of employees through V-V or V-P interactions, then CPS would be the engineering control to mitigate that risk. This can only be determined through a TMP risk assessment and where TMP controls cannot mitigate the risk, engineering controls (CPS) will be required. This risk assessment would therefore also form a critical part of the Section 21 file and would be mine specific	As per success criteria	
11	CPS operating technical specification	CPS provider (CxD, interface or OEM) issued operating manual (manual may include maintenance and spares)	As per success criteria	
12	CPS maintenance technical specification (including spares)	CPS provider (CxD, interface or OEM) issued maintenance manual (manual may include operating and maintenance spares)	As per success criteria	
13	CPS operating and maintenance training manual for train the trainer	CPS provider (CxD, interface or OEM) issued training guideline or training manual that can be used for train the trainer training and course development.	As per success criteria	

14	CPS operating and maintenance training manual	CPS provider (CxD, interface or OEM) issued training manual that can be used by trainers for course development or as is for training.	As per success criteria	
15	Hazardous materials	Material Safety Data Sheets	As per success criteria	

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TRL 1 CERTIFICATE OF CONFORMANCE

CPS PRODUCT: SUPPLIER CXD:

Herewith(Legal Entity) confirms that it conforms to the requirements as set out for the **Technology Readiness Level ...** as per the company's inhouse requirements as well as the requirements of the SAMI as defined in the **Industry Alignment on TMM Regulations; Special Project of The Minerals Council South Africa documentation.**

This certificate is issued by...._____

Name:

Designation:

It is certified that all the information as is indicated in the attached information register(s)

- has been developed in accordance with the standards and requirements as set out in the Product quality assurance and verification plan.
- Has been verified inhouse by
- Has been independently verified by ..

Information/Document Title	Unique Identifier	Rev	
SAMI CPS Requirements Analysis			
Legal Liability assessment(s)			
OEM Spec sheets			
Quality and Development Management			
Quality, design and development standards (Hardware and Software)			
Quality Plan(s)			
Conformance management			
Design for Safety			

Verification and Validation			
Simulation			
Configuration and Change Management			
Information Trees			
Information Registers			
Version Control			
Project Management			
Functional Analysis, requirements allocation, product breakdown structure(s)			
Trade off Studies			
Standardisation Studies			
Requirements Specification			
Risk Assessment			
Industry Collision Risk studies			
Unintended consequence and human factors analysis			