

**CAS Project
Baseline controls**

Item	CAS baseline control	Applicable (Y/N)	Standard (Y/N)	TMM types and or pedestrians	Notes	Control Standard
1	Operator and pedestrian response time	Y	Y	All	Industry norm 2,5 sec	2,5 sec
2	Zones:	Y	Y	For all TMMs	Dynamic based on speed and ISO 21815-3. Deceleration and Stopping in accordance with SANS 1589-3 and ISO 21815-3.	Stop gap: 2,5m and 5m irrespective of the TMM Traveling speed Zone sizes to be calculated based on TMM type brake performance, CPS / CAS , machine delay times and the velocity at which the machine is traveling
2.1	Zones: Dynamic / Static	Underground and surface: Dynamic	Y	For all TMMs	All decision for mines (surface and underground), plants	U: Dynamic Zone S: Dynamic Zone Records needs to be kept of all STOP commands especially on hydrostatic machines due to the limitation of emergency brake usage.
2.2	Stability / consistency	Y	Y	All		Reliability 99,9 [%]
2,3	Zone shape to accommodate all heights of attachments	Y	Y			<ul style="list-style-type: none"> • All TMM • All zones needs to verified around the machine to ensure that no blind spots are present
2,4	Zone shape to follow articulation	Y	Y			All TMM
2,5	Verification	Y	Y		Current verification controls needs to be revised. Control is not effective and is not done on a continues basis	Zone Measurement Control (Gate, light)

CAS Project

 Baseline controls

Item	CAS baseline control	Applicable (Y/N)	Standard (Y/N)	TMM types and or pedestrians	Notes	Control Standard
3	Fail to safe	Y	Y		Not fail to safe, antenna fails, operator will not know	<ul style="list-style-type: none"> • See fail to safe definition in Abbreviations and definitions standard • System Continuously Auto Check • Above must be on pre-start checklist • Fail to safe on both machine and CPS / CAS unit <p>a) The CMS solution should incorporate measures to prevent entering an unsafe condition and fail to a safe state in the event of any malfunction;</p> <p>b) The CPS solution should default to a safe state when any component, connection or interface that governs functionality fails as detected by the self-diagnostic capability;</p> <p>c) The CPS and OEM diagnostics built into the CPS solution should provide a suitable warning signal to the operator, or the pedestrian, if an error condition is detected;</p> <p>d) The CPS solution should default to a safe state when any of the following conditions occur that could impact the safe operation of the system:</p> <ul style="list-style-type: none"> o no power on the system, o the connected antennas are not functional, o any system faults are detected, o a communication error is detected, o any battery required by the system fails to maintain a minimum operating voltage or power to enable proper operation, o a faulty machine or pedestrian component is detected, or o any component failure; <p>e) The CPS solution should react in an appropriate manner at all times defined through design risk assessments (conducted independently by the CPS supplier and the OEM) to specify inherent failure modes of the system components, and confirmed by an operational risk assessment (conducted jointly with all parties by the user user) to identify any additional control measures to ensure safe operation of the system.</p>

CAS Project
Baseline controls

Item	CAS baseline control	Applicable (Y/N)	Standard (Y/N)	TMM types and or pedestrians	Notes	Control Standard
4	Effective warning (including ergonomics)	Y	Y		Essential to have pedestrian and operator cap lamp working and or PAD for surface for effective warning.	<ul style="list-style-type: none"> • Effective Warning: For surface TMMs: The expected outcome of the operator action is that the potential collision is prevented, therefore an effective warning must inform the operators of both TMMs what the appropriate action(s) are, to prevent the potential collision. • Effective Warning: For Underground TMMs: The expected outcome of the operator and pedestrian action is that the potential collision is prevented. Therefore, an effective warning must inform the operators of TMMs what the appropriate action(s) are to prevent the potential collision and must alert the pedestrian to potential collisions, or interactions with TMMs in the vicinity.(All Machines) both operator and pedestrian
5	Data logging	Y	Y		Must verify	90 [days], (10Hz) , CxD + Machine
6	Response time Machine	Y	Y			500 ms between TMM and CxD used for zone calculations
	Response time CxD					500 ms between TMM and CxD used for zone calculations
7	Stop gap	Y	Y	LHD, DT	2,5 M stopgap industry norm.	U: 2,5 [m] Irrespective of TMM Traveling speed S: 5 [m] Irrespective of TMM Traveling speed
8	TMM acting as a beacon	Y	Y			<ul style="list-style-type: none"> • Definitely for the machines defined in TMM Types • All TMM to act as beacon when parked and isolator is switched off (not applicable for NRE)
	Beacon as speed control	Y	N		TMMs travel slow, only 1st gear enabled	
9	CPS – TMM interface - Interface specification (ISO 21815-2:2021 etc.)	Y	N		OEM, sort out battery limits between suppliers	<ul style="list-style-type: none"> • Standard interface for all TMM's • Synchronised time stamp between CxD and TMM
10	Rock penetration	Y	N		Confirm , penetrate the bucket	<ul style="list-style-type: none"> • Must have rock penetration and bucket penetration, fully) loaded bucket penetration at all heights (Calculate pedestrian walking speed *2,5 [sec])
11	Interference	Y	Y		Influenced by cabling, structures, confirm with CxD Tablets, Radio, Remote controlled machines, cell phones ,Wi-Fi, cover sensor	<ul style="list-style-type: none"> • Must comply with SANS 13766, (VSD requires harmonic filters)
12	Loop size / passenger exclusion zones	Y	N		Define the loop size and report on maintaining it	<ul style="list-style-type: none"> • Silent zone must be the exact shape of the TMM interior (10mm maximum from vehicle interior)
13	Prioritization between pedestrians and TMM's	Y	N	LHD, DT	Not confirmed whether it is applicable on all TMM's	<ul style="list-style-type: none"> • Surface and UG :V-P legal requirement • Multiple interactors. Amount of TMM's and pedestrians

**CAS Project
Baseline controls**

Item	CAS baseline control	Applicable (Y/N)	Standard (Y/N)	TMM types and or pedestrians	Notes	Control Standard
14	Maintenance	Y	Y		Needs to be revised (SAT required if components have been replaced) Revise procedure to indicate what gets preference	<ul style="list-style-type: none"> • Must be logged as part of log keeping • Must be fully maintained according to CxD / CPS supplier maintenance plans each time TMM comes in for service or every 30 [days]. SATs to be done every 90 days • Works order needs to be generated by CMMS with all tasks on works order • Outstanding works orders to be tracked • SLA to include: See two additional worksheets • CAS / CPS system must fail to safe if a threshold of 35 days are reached and not been maintained by the supplier • RCA to be performed on all failures detected [in accordance with engineering problem resolution standard] • Confirm that the signal send is the correct signal
15	Lamp testing	Y	Y		Intelligent lamp room	<ul style="list-style-type: none"> • 100 [%] use of testing station before going UG. • Each lamp needs to be tested and if it does not pass the test, the turnstile must block the person from going through • Lamps man to perform random checks and burn downs? • Procedure to be updated (Lamp room management procedure) • Training procedure to be updated
16	Calibration of CPS system and control of software version	Y	N		Standard will be drafted	<ul style="list-style-type: none"> • New system installed: CoC standard • Existing system: During maintenance • Any software change needs to be noted as part of the TMM's maintenance history on the CMMS and be accompanied by an engineering change request • Before any software change is installed on the CPS system, the Responsible Engineer needs to sign off the request and be informed of: <ol style="list-style-type: none"> 1) What will be changed 2) Will it have an influence on detection of the other TMM's with the older software version 3) The test report indicating all tests that were conducted by the CPS supplier before it was approved 4) Change in training material if it is relevant 5) In line with Samancor change management procedure
17	In service testing	Y	N		Standard will be drafted	<ul style="list-style-type: none"> • Must be in accordance with the in service testing procedure • Part of maintenance • Part of calibration • Part of zone verification

CAS Project
Baseline controls

Item	CAS baseline control	Applicable (Y/N)	Standard (Y/N)	TMM types and or pedestrians	Notes	Control Standard
18	Ergonomics	Y	Y			<p>Ergonomics. Ergonomics involves designing the CPS to fit the needs of the and pedestrian rather than trying to make the operator and pedestrian to adjust to the CPS. Typically this must include:</p> <ul style="list-style-type: none"> • The operator and pedestrian must receive effective warnings without any false positives or annoyance alerts, • The inclusion of the CPS must not interfere with the operator or pedestrian vision, • The CPS must not induce operator or pedestrian fatigue, • The CPS must not introduce any health risks to the operator or pedestrian. • Alarm type: Alarm sound, voice, alarm, light etc
17	Competency and training (Maintenance)	Y	Y			<ul style="list-style-type: none"> • Certified competent and linked to access control • SLA • Continuous refresher training
18	Competency and training (Pedestrians)	Y	Y			<ul style="list-style-type: none"> • Certified competent and linked to access control • Continuous refresher training
19	Competency and training (Operator)	Y	Y			<ul style="list-style-type: none"> • Key control system to be linked to competency • Continuous refresher training • Licensing procedure(To reflect the above)
20	Override / Standby	Y	Y		Form part of conditional release as per defintion standard	<ul style="list-style-type: none"> • CxD: Operator override in emergencies only • TMM: Authorised override only by OEM • Each standby / override to be reported to management for investigation (conditional release) • Operator bypass risk assessment to be done
21	No Negotiation Sequence	Y	N			<ul style="list-style-type: none"> • Included in the standard interface
22	Articulation Lock	Y	Y			<ul style="list-style-type: none"> • Must disable articulation if a pedestrian is in the danger zone
23	Power supply	Y	Y			<ul style="list-style-type: none"> • CPS system must have a power supply filtering out voltage spikes to CPS antennas (PDU)