Building and Construction Authority

An MND Statutory Board

MINISTRY OF MANPOWER

2 Feb 2024

To: All firms registered in CRS, FM Registry, Suppliers Registry and PSPC consultants

(Sent via BCC)

ENHANCEMENT TO WORKPLACE SAFETY & HEALTH REQUIREMENTS IN PUBLIC SECTOR CONSTRUCTION AND CONSTRUCTION-RELATED PROJECTS:

(1) HARMONISED WSH REQUIREMENTS ACROSS PUBLIC SECTOR PROJECTS
(2) ENHANCED SAFETY-RELATED TENDER EVALUATION CRITERIA
(3) MEASURES TO INCENTIVISE GOOD WSH STANDARDS

This circular informs the Built Environment sector of the enhancement to the Workplace Safety & Health (WSH) requirements for the procurement of construction services that shall take effect for construction and construction-related tenders called on and after **1 April 2024** (unless otherwise stated).

Background

2 The Multi-Agency Workplace Safety and Health Taskforce[1] (MAST) was set up in Oct 2022 to (a) identify sectoral strategies to improve the WSH performance and (b) strengthen sectoral engagements with companies to reinforce the importance of WSH. Under the guidance of MAST, BCA and MOM have been actively engaging industry stakeholders to develop targeted measures for the public sector to take the lead in raising the emphasis of safety for both the Main Contractors and all levels of Subcontractors. This would then strengthen WSH ownership and outcomes for the construction sector.

(1) Harmonised WSH Requirements Across Public Sector Projects

(1A) Extension of the Safety Disqualification (SDQ) Framework

3 To align the evaluation criteria and temporarily disqualify contractors with poor WSH performance from participating in public sector tenders, the SDQ Framework was

[1] The tripartite composition of MAST includes Ministry of Manpower, Ministry of National Development, Ministry of Sustainability and the Environment, Ministry of Transport, Ministry of Trade and Industry, Ministry of Health, Industry Leaders and the labour movement.

implemented from 1 Oct 2022. It was applied to the Main Contractors and their first level Subcontractors for public sector construction projects using the Price-Quality Method (PQM) – i.e. under the BCA Construction Workheads (CW01 & CW02) with an estimated construction cost ≥ $3mil.

4 **Scope**: The SDQ Framework will be extended to public sector construction and construction related projects not using the PQM, in which the tenders are called under the BCA Construction[2] Workheads (CW01 & CW02) and Construction Related[3] Workheads (ME & CR):

a) For projects with estimated construction cost > $90k to ≤ $1mil.
The SDQ will be applicable to Main Contractors only; and

b) For projects with estimated construction cost > $1mil.
The SDQ will be applicable to Main Contractors and all levels of Subcontractors working in the project.

Table 1: Extension of the SDQ Framework

S/N	Details
At Tender Stage:	
1	For projects > $90k, Government agencies will conduct checks on whether the tenderers meet any of the SDQ criteria: a) Entry into MOM's Business Under Surveillance programme (BUS) i. Has entered BUS within the 3 months prior to the Tender Closing Date[4]; or ii. Has entered BUS after the Tender Closing Date, but before the Tender Award Date (both dates inclusive); b) Debarred by MOM from employing foreign employees due to the accumulation of 25 or more Demerit Points under MOM's Demerit Point System i. Debarred under MOM's Demerit Point System at the Tender Closing Date; or ii. Debarred under MOM's Demerit Point System between the Tender Closing Date and Tender Award Date (both dates inclusive).
Firms can refer to the PQM Framework and Annex A for more details. Firms can use MOM's Checksafe eservice to check if the contractors meet any of the SDQ criteria above.	
At Construction Stage:	
2	For projects > $1mil, Main Contractor is required to put in place a system to ensure SDQ enforcement across all levels of Subcontractors in the project. The firm will not

[2] Refers to CW01-General Building and CW02-Civil Engineering workheads under BCA's Contractors Registration System (CRS).
[3] Refers to Mechanical & Electrical (ME) and Construction-Related (CR) workheads under BCA's CRS.
[4] Tender Closing Date refers to the first published tender closing date, regardless of subsequent extension.

S/N	Details
	be allowed to be appointed as a Subcontractor if it meets either of the disqualifying criteria: a) Entered MOM's Business Under Surveillance (BUS) programme within the 3 months prior to date of Letter of Award issued by the Main Contractor/ Subcontractor to its Subcontractor/ next level of Subcontractor respectively; or b) Debarred by MOM from employing foreign employees due to the accruement of 25 or more Demerit Points under MOM's Demerit Point System as at the date of Letter of Award.
3	For projects > $1mil, Main Contractor is required to rectify any non-compliance to the SDQ framework, e.g. by removing any disqualified Subcontractor which has been appointed.

(1B) Include standardised safety requirements in Particular Conditions

6 Standardised safety requirements will also be included in the contract with Main Contractors in (i) identifying and implementing WSH trainings/ competencies specific to site activities to workers on site; (ii) exercising enhanced safety commitment, including periodic reporting of WSH performance, organising engagement sessions, and implementing improvement plans for poor-performing Subcontractors; and (iii) conduct risk assessments and ensure compliance by all Subcontractors. Refer to Table 2.

7 **Scope**: These requirements are applicable to public sector construction and construction related tenders under the BCA Construction Workheads (CW01 & CW02) and Construction Related Workheads (ME & CR) for projects > $1mil.

Table 2: Standardised safety requirements

S/N	Details
At Tender Stage:	
1	For projects > $1mil, agencies will include the standardised clauses on safety requirements to the contract between the agency and the main contractor. BCA will provide more details on the sample clauses in a separate circular.
At Construction Stage:	
2	For projects > $1mil, Main Contractor is required to put in place a system to ensure compliance to the requirements across all levels of Subcontractors in the project. Firms can refer to Annex A for more details.

(2) Enhanced Safety-related Tender Evaluation Criteria

8 Currently, under the PQM framework (for construction tenders ≥ $3mil under BCA Construction Workheads CW01 & CW02, the minimum weightage for safety-related criteria is at least 3% of the overall PQM score.

9 **Scope**: The enhancement to the safety-related criteria are as follows and in Table 3:

a) For construction tenders using PQM: The minimum weightage will be raised to 15% of Quality weightage or 5% of the overall PQM score, whichever is higher. This is to further differentiate potential tenderers based on safety, beyond existing upstream measures such as the SDQ Framework. This will apply to all public sector construction tenders using PQM, under the BCA Construction Workheads (CW01 & CW02), for projects ≥ $3mil.

The current safety-related criteria typically evaluate a contractor's past safety performance or safety track record. To encourage contractors to consider and propose safety enhancements, the scope of the criteria will be expanded beyond safety performance e.g. agencies could require tenderers to submit innovative proposals related to WSH. One such proposal could be to adopt safer construction methods or deploy WSH technologies to improve risk monitoring and WSH outcomes.

b) For construction and construction-related tenders >$1mil which are not using PQM: As there is currently no requirement to evaluate the safety credentials of the tenderers during tender evaluation for projects not using PQM, the minimum weightage of 5% for safety-related criteria will be applied to public sector construction and construction related tenders not using PQM under the BCA Construction Workheads (CW01 & CW02) and Construction Related Workheads (ME & CR), for projects > $1mil.

Table 3: Enhanced safety-related criteria

S/N	Details
At Tender Stage:	
1	For tenders called using PQM (i.e. CW01 & CW02 projects ≥ $3mil), agencies will increase the minimum weightage and expand the scope of the safety-related criteria e.g. to include innovative proposals related to WSH, such as technology adoption.
2	For CW01, CW02, ME & CR tenders not using PQM with value > $1mil, agencies will include safety-related criteria in the tender evaluation criteria with minimum weightage of 5% for safety-related criteria.
Firms can refer to the PQM Framework for the suggested safety-related criteria.	

(3) Measures to Incentivise Good WSH Standards

(3A) Adoption of Mature WSH Technology

10 **Scope**: Main Contractor is required to adopt mature WSH technology to enhance safety and raise productivity on-site for public sector construction and construction-related projects ≥ $3mil. Refer to Table 4.

11 The technology should include:

a) Electronic Permit-to-Work System (ePTW) which allows full visibility of ongoing high-risk activities and identifies conflicting works; and

b) Vehicular Safety Technology (VST) which detects and manages driver/operator fatigue, and minimises potential collisions and accidents.

12 These requirements are applicable to public sector construction and construction related tenders under the BCA Construction Workheads (CW01 & CW02) and Construction Related Workheads (ME & CR) for projects ≥ $3mil.

Table 4: Adoption of mature WSH technology

S/N	Details
At Tender Stage:	
1	For CW01, CW02, ME & CR projects ≥ $3mil, agencies to include the ePTW and VST specification in the tender document. Firms can refer to the Annex B and Annex C for the ePTW and VST specifications respectively.
At Construction Stage:	
2	For CW01, CW02, ME & CR projects ≥ $3mil, the Main Contractor is required to implement the proposed WSH technologies on site. Firms can refer to Annex A for more details.

(3B) Adoption of WSH Bonus Scheme

13 The WSH Bonus Scheme serves to incentivise good safety performance during the construction phase. Contractors can use the rewards to recognise the efforts of on-site workers in upholding good safety standards, to create a reinforcing cycle of a strong safety culture.

14 **Scope**: Government agencies will be required to adopt the WSH Bonus Scheme, and to ensure that Main Contractors allocate a portion of the Bonus to reward workers. This will be applicable to public sector construction and construction related tenders ≥ $50mil under the BCA Construction Workheads (CW01 & CW02) and Construction Related Workheads (ME & CR). Refer to Table 5.

Table 5: Adoption of WSH Bonus Scheme

S/N	Details
At Tender Stage:	
1	For CW01, CW02, ME & CR projects ≥ $50mil, agencies will include the WSH Bonus Scheme specification in the tender document.
At Construction Stage:	
2	For CW01, CW02, ME & CR projects ≥ $50mil, agencies will implement the WSH Bonus Scheme on site. This could include (a) Carrying out regular assessment on the Main Contractor, (b) Managing the progress bonus payment to the Main Contractor. Firms can refer to Annex A for more details.

Clarification

15 Contractors can refer to the revised PQM framework for these changes. The revised PQM framework can be downloaded from https://www1.bca.gov.sg/procurement/tender-stage/price-quality-method-pqm-framework.

16 For clarification related to the PQM Framework and circular, please direct your queries to BCA (Link: https://www.bca.gov.sg/feedbackform/).

17 For an overview of the applicability of the enhancements based on the types of projects, refer to Table 6.

Table 6: Overview of applicability of enhancements

Project Type / Project Sum	Construction Projects (Enhancement)	Construction-related Projects (Enhancement)
> $90k to ≤ $1mil	(1A) SDQ Framework applicable to Main Con only.	(1A) SDQ Framework applicable to Main Con only.
> $1mil to < $3mil	(1A) SDQ Framework applicable to Main Con & all levels of Subcontractors. (1B) Include standardised safety requirements in Particular Conditions (2) Safety-related criteria min weightage set at 5% of tender evaluation criteria	(1A) SDQ Framework applicable to Main Con & all levels of Subcontractors. (1B) Include standardised safety requirements in Particular Conditions (2) Safety-related criteria min weightage set at 5% of tender evaluation criteria
≥ $3mil	(1A) SDQ Framework applicable to Main Con & all levels of subcontractors. (1B) Include standardised safety requirements in Particular Conditions (2) Safety-related criteria min weightage raised to 15% of Quality or 5% of overall PQM score (3A) Adoption of Mature WSH Technology	(1A) SDQ Framework applicable to Main Con & all levels of subcontractors. (1B) Include standardised safety requirements in Particular Conditions (2) Safety-related criteria min weightage set at 5% of tender evaluation criteria (3A) Adoption of Mature WSH Technology
≥ $50mil	(1A) SDQ Framework applicable to Main Con & all levels of subcontractors. (1B) Include standardised safety requirements in Particular Conditions (2) Safety-related criteria min weightage raised to 15% of	(1A) SDQ Framework applicable to Main Con & all levels of subcontractors. (1B) Include standardised safety requirements in Particular Conditions (2) Safety-related criteria min weightage set at 5% of tender evaluation criteria

Project Type / Project Sum	Construction Projects (Enhancement)	Construction-related Projects (Enhancement)
	Quality or 5% of overall PQM score (3A) Adoption of Mature WSH Technology (3B) Adoption of WSH Bonus Scheme	 (3A) Adoption of Mature WSH Technology (3B) Adoption of WSH Bonus Scheme

Thank you.

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Enc:
Annex A: Summary & Implementation Guide
Annex B: Electronic Permit to Work Specification Template
Annex C: Vehicular Safety Tech Specification Template

(Transmitted via email)

ANNEX A: SUMMARY AND GUIDE TO IMPLEMENT THE ENHANCED SAFETY REQUIREMENTS AND ADDITIONAL MEASURES IN PUBLIC SECTOR PROJECTS

Overview of Detailed Measures on Enhancing Safety Requirements in Public Tenders

1. This annex serves to guide contractors in implementing measures that provide a more comprehensive and harmonised assessment of a firm's workplace safety and health (WSH) performance.

2. The following words shall have the meanings assigned to them.

   a. "Subcontractor" refers to a person engaged (under a contract of service) by any contractor to (i) supply any labour, or (ii) do any construction or (iii) construction-related work at the project site. Contractors who only supply and deliver materials to site are excluded.
   b. "construction project" refers to public sector project in which the tender is called under the BCA Contractor Registration System (CRS) CW01 and CW02 workheads.
   c. "construction-related project" refers to public sector project in which the tender is called under the BCA CRS CR and ME workheads.

Enhancement 1: Harmonised WSH requirements across public construction and construction-related projects

3. Enhancement 1 aims to extend WSH oversight to contractors throughout the supply chain, place strong emphasis on top management's WSH responsibility, and inculcate a more pervasive training culture beyond foundation training.

Table 1: Measures under Enhancement 1.

S/N	Measure	Details
1A	Extend Safety Disqualification (SDQ) Framework for construction and construction-related projects: • for projects > $90k to ≤ $1mil, applicable to Main Contractor only; and • for projects > $1mil, applicable to main and all levels of subcontractors. Main Contractor/ all levels of Subcontractors meeting any of the following criterion will be disqualified/ not allowed to be appointed: *Entry into MOM's Business Under Surveillance programme (BUS)* • *Has entered BUS within the 3 months prior to the tender closing date; or* • *Has entered BUS after the tender closing date, but before the tender award date.*	At Tender Stage: i. For projects > $90k, GPEs to conduct checks on whether the tenderers meet the Safety Disqualification Criteria. ii. For projects > $90k, GPEs to include the additional clauses to the: • Critical evaluation criteria; • Instruction to Tenderers; and • Particular Conditions (applicable only for projects >$1mil) Refer to the PQM Framework for more details. At Construction Stage: The Main Contractor must demonstrate due diligence to the GPE by having a

S/N	Measure	Details
	Barred by MOM from employing foreign employees under MOM's Demerit Point System (DPS) • *Was being barred under MOM's DPS at the tender closing date; or* • *Was being barred under MOM's DPS between the tender closing date to tender award date (both dates inclusive)*	system in place to ensure SDQ enforcement across all levels of contractors in the project: i. All Subcontractors (regardless of level of subcontracting) are required to declare that they have checked their own appointed subcontractors against SDQ criteria – BUS and DPS, and verified that they are not disqualified before engaging their service. ii. If declaration form is used, it must minimally include the following details, and be in such a manner as required by the Main Contractor: • Unique Entity Number (UEN) of the engaged Subcontractors; • Date of contract agreement; • Records of checks against MOM CheckSafe iii. This declaration form must be submitted to the Main Contractor, and the Main Contractor must perform a sample check against MOM CheckSafe and maintain a record of this check. If the Main Contractor is found without such a system onsite, or if disqualified Subcontractors have been hired for the project, the Main Contractor needs to rectify this with an action plan. For example, the Main Contractor needs to implement a verification system within a stipulated timeframe, including instructing their contractor to terminate the particular disqualified Subcontractor.
1B(i)	Require Main Contractor to identify and implement WSH trainings/competencies specific to site activities for construction and construction-related projects > $1mil.	<u>At Construction Stage</u>: The Main Contractor must demonstrate due diligence to GPE by: i. Conducting site-specific briefings to all new incoming workers to familiarise them with in-house rules and high-risk activities on the site. ii. Ensuring all workers hold the requisite training and competency required for their

S/N	Measure	Details
		specific job, beyond the foundational safety orientation courses. Examples of systems that Main Contractors can establish include: • Requiring Subcontractors to submit details of their workers' specific and necessary competencies before accessing the worksite. • Conducting video safety briefings for new incoming workers and workers who have not been to the site for more than half a year. • Holding regular site coordination meetings, or during daily toolbox meetings when appropriate, to verify that all workers have completed the requisite training and possess the competency required for their specific job.
1B(ii)	Require Main and subcontractors' management to exercise enhanced safety commitment for construction and construction-related projects > $1mil.	<u>At Construction Stage</u>: The Main Contractor must demonstrate due diligence to GPE by: i. Providing periodic reports on WSH performance to the GPE, including that of their Subcontractors. ii. Organising engagement sessions with representatives of Subcontractors' management and the GPE to discuss WSH performance and issues. iii. Identifying poor-performing Subcontractors and implementing an improvement plan involving the management of the identified Subcontractor.
1B(iii)	Require Main Contractor to conduct Risk Assessment and ensure compliance of Method Statement by all subcontractors for construction and construction-related projects > $1mil.	<u>At Construction Stage</u>: Main Contractor must demonstrate due diligence to GPE by: i. Conducting risk assessment in relation to the WSH risks posed to any person who may be affected by the Main Contractor's undertaking at the site.

S/N	Measure	Details
		ii. Ensuring that a method statement together with the risk assessment for safety critical work activities, where applicable (e.g. lifting operation, excavation, shoring, confined space), are implemented before work commences. iii. Informing all persons involved in the work activity on the nature of the risk involved, the measures taken to minimise the risk, and the safe work procedures to control the risk. iv. Ensuring that all Subcontractors engaged for each trade also comply with the method statement.

Enhancement 2: Enhanced safety-related tender evaluation criteria

4. Enhancement 2 aims to further differentiate potential tenderers based on WSH performance, beyond existing upstream measures, such as SDQ framework.

Table 2: Measures under Enhancement 2.

S/N	Enhancement	Details
2A	For construction and construction-related tenders >$1mil which are not using PQM: Require at least 5% weightage on safety	At Tender Stage: i. For CW01, CW02, ME & CR tenders not using PQM with value > $1mil, to include safety-related criteria in the tender evaluation criteria with minimum weightage of 5% for safety-related criteria. ii. For tenders called using PQM (i.e. CW01 & CW02 projects ≥ $3mil), to increase the minimum weightage and expand the scope of the safety-related criteria beyond safety performance. GPE can consider specifying the following suggested safety-related criteria, beyond the MOM's DPS which is currently used by GPEs. i. MOM's BUS
2B	For construction tenders using PQM: • Require a minimum of 15% of Quality weightage for evaluation of safety related criteria, or 5% of total PQM score, whichever is higher. • Broaden the scope of safety performance under the BCA's Price-Quality Method (PQM) framework to safety related criteria.	

S/N	Enhancement	Details
		ii. WSH Technology proposed by tenderers, where applicable (e.g. beyond the WSH tech included in regulations and contract specifications) iii. Safety track record (e.g. past demerit points based on GPEs' in-house assessment in the past 2 years) iv. Safety proposals (e.g. preliminary risk assessment with corresponding control measures) v. Safety accreditation and awards (e.g. WSH Award, BizSAFE Awards) vi. Other GPE's in-house safety performance/awards records Refer to the revised PQM Framework for the suggested safety-related criteria.

Enhancement 3: Measures to incentivise good WSH standards

5. Enhancement 3 aims to strengthen the adoption of WSH Technology, a key enabler for detecting and preventing workplace incidents, and incentivise good WSH performance by awarding WSH Bonus Scheme.

Table 3: Measures under Enhancement 3.

S/N	Enhancement	Guide to implement
3A	Require Main Contractor to adopt mature WSH technology for construction and construction-related projects ≥ $3mil. Mature WSH technologies: • Electronic Permit to Work (ePTW) • Vehicular Safety Technology (VST)	At Tender Stage: GPEs should include the ePTW and VST specification in the tender document, where applicable. Refer to the Annex B and Annex C for the ePTW and VST specifications respectively.
		At Construction Stage: The Main Contractor should demonstrate their adoption of ePTW and VST at their worksite to the GPE.
3B		At Tender Stage:

S/N	Enhancement	Guide to implement
	Require GPEs to include WSH Bonus Scheme for construction and construction-related projects ≥ $50mil. • Suggested total bonus amount is pegged at 0.5% of awarded Contract Sum, subject to a bonus cap of $1mil. • Nevertheless, GPEs have the flexibility to amend the total bonus amount and the bonus cap.	For CW01, CW02, ME & CR projects ≥ $50mil, to include the WSH Bonus Scheme specification in the tender document. <u>At Construction Stage</u>: <u>General Principles</u> i. GPEs are required to include a WSH Bonus Scheme for construction and construction-related projects with estimated procurement value ≥ $50mil, and ensure that the Contractors allocate a portion of the Bonus for rewarding workers. ii. The total bonus amount is pegged at 0.5% of awarded Contract Sum, subject to a bonus cap of $1mil. Nevertheless, GPEs have the flexibility to offer a higher total bonus amount beyond the specified cap. iii. GPEs should establish the basis for payout primarily through an assessment of the site's WSH performance. This could involve implementing a monthly or quarterly assessment on the WSH performance of the site and paying a bonus to the Main Contractor if the site meets the assessment criteria for that period. iv. To reinforce that good WSH performance is a collective effort, Main Contractor should allocate a portion of the WSH bonus for rewarding workers, including that of direct and indirect Subcontractors engaged by the Main Contractor.

ANNEX B: ELECTRONIC PERMIT-TO-WORK SPECIFICATIONS TEMPLATE

General Requirements

1) The system must be able to generate, submit and process paperless Permit-To-Works (PTWs).
2) The information required must include but not limited to the date, time, requester, assessor, approver, work location, description, pictures, checkbox for questions and answers (if applicable).
3) The system should have the ability to pinpoint and capture the location of the mobile device used so as to show that the creation, submission and approval of the PTW are done on site.
4) Users must be able to pre-set workflows to automate processes. These processes include recording observations, acknowledging observations, submitting closure report, verifying report, revoking e-PTW and closing the permit on mobile devices. The workflows must not be skipped i.e. from applicant to approver directly.
5) The e-PTW must ensure that only the authorised persons can assess and approve the permit to work. There must be safeguards to disallow falsification.
6) The e-PTW must be able to capture data such as text, date, multiple photos per inspection, comment, time stamp of data input or changes and identity of users. It must have an audit trail for investigation purposes.
7) Site drawings, photos and supporting documents should be able to be attached to the e- PTW form and be electronically routed to the authorised person via their mobile devices. Notification must be sent to the authorised person once submission of the form is done for the responsible person's assessment and approval of the e-PTW.
8) User must be able to set a deadline for the Permit expiry. The system must trigger automated alerts to relevant supervisors to follow up on cases close to expiry in accordance to the pre-set workflow.
9) The e-PTW application must allow the authorised person to revoke an issued permit to work, if the work is unsafe to proceed or poses a risk to the safety, health and welfare of persons at work.
10) The information must be able to be viewed, validated and approved by the stipulated deadline.
11) The web interface dashboard of the e-PTW system must be able to show which are the live Permits, which Permits have closed and which Permits are being reviewed.
12) Each e-PTW must have its own unique identification number.
13) Default language of the e-PTW must be in English.

System performance

14) The e-PTW application must be able to run on all major mobile platform devices such as Andriod and iOS, including any new software updates to the mobile platform. The web interface of the app must be compatible with commonly available browsers in the market.
15) The e-PTW must be accessible over the internet and be able to function with or without live connection. The data must be synchronised in real time once live connection is established. Users must be able to access the e-PTW from mobile device or web-based interface.

Record retrieval

16) Upon request by any relevant agency, such as MOM officers during on-site inspection, the e-PTW documents must be retrievable and available.
17) The digital e-PTW should be convertible to PDF format if required, printable and be used as hardcopy reference.
18) The e-PTW data should be downloadable in structured form in MS Excel to aid statistical analysis upon any relevant agency's request.
19) Past records must be kept and maintained for a minimum of 5 years from the PTW creation date.
20) All records must not be modified after approval and completed.

Training

21) The contractor must provide adequate training to users of the e-PTW system. The contractor must ensure that users have a mobile device that can interface with the e-PTW.

ANNEX C: VEHICULAR SAFETY TECHNOLOGY SPECIFICATIONS TEMPLATE

GPEs can use the guided specifications below, where appropriate, that is suitable for the vehicle type and work environment.

A) Proximity Sensing and Warning Sensor

1) Alert the heavy equipment operator when a person or object is detected in the Areas of Risks (AOR)[5] and blind area, and trigger an alarm with blinker to warn the person at risk. If the alarm is not audible for the operator, there should be a separate alarm in the operator cabin and a digital display if appropriate.
2) False alarms shall be minimised by getting the suitable model or customisation by solution vendor to ensure that the false alarm rate is as low as reasonably practicable.
3) Perform reliably in adverse climatic and weather conditions.
4) Allow for configuration of detection distance is required.
5) Provide training and demonstrate that operators and supervisors have received training in the care, maintenance, safety rules, use and limitations of the system.
6) Perform regular maintenance and reinstate to working condition when the system malfunctions.
7) Obtain necessary approval from vehicle manufacturers if the system requires tapping into the electronics and control systems of the heavy vehicles/equipment.
8) Ensure visual and audio alerts are unique such that operators and supervisors can differentiate whether the alerts are from this Proximity Sensing and Warning Sensor, or from other system such as Driver Fatigue Management System.
9) Ensure that the system, including the alerts cannot be bypassed or turned off by operator during equipment operation. Any bypass required for operational needs, e.g. if vehicle is parked beside a wall, shall be controlled by the supervisor or other authorised personnel.

B) Camera Monitor System

1) Provide heavy equipment operator with visual monitors in the cabin to have a clear image of a person or object in the AOR.

[5] Areas of risk (AOR) is defined as areas of obstructed view that would fall within the equipment's direction of movement, where a person or object cannot be seen by the equipment operator in the normal operating position, either by direct line-of-sight or even with the use of mirrors.

2) The image of a person or object in the LCD monitor must be clear and easily identifiable.
3) Perform reliably in adverse climatic and weather conditions.
4) Allow for capturing of video data for retrieval, playback and analysis.
5) Provide training and demonstrate that operators and supervisors have received training in the care, maintenance, safety rules, use and limitations of the system, including reminders that the camera is a supplement device that still requires the operator to use it in conjunction with the vehicle mirrors or systems for maximum coverage.
6) Perform regular maintenance and reinstate to working condition when the system malfunctions.
7) Obtain necessary approval from vehicle manufacturers if the system requires tapping into the electronics and control systems of the heavy vehicles/equipment.
8) Ensure that the system cannot be turned off by operator during equipment operation.

C) <u>Driver Fatigue Management System</u>

1) Detect signs of driver fatigue and distractions when heavy equipment is in operation, including but not limited to drowsiness, dozing off, using of mobile device, looking away, eating, and smoking.
2) Alert heavy equipment operator and supervisor in real-time when driver fatigue or distraction is detected.
3) Provide analytical dashboard and reports for reporting and trend analysis.
4) Provide training and demonstrate that operators and supervisors have received training in the care, maintenance, safety rules, use and limitations of the system.
5) Perform regular maintenance and reinstate to working condition when the system malfunctions.
6) Obtain necessary approval from vehicle manufacturers if the system requires tapping into the electronics and control systems of the heavy vehicles/equipment.
7) Ensure visual and audio alerts are unique such that operators and supervisors can differentiate whether the alerts are from this Driver Fatigue Management System, or from other system such as the Proximity Sensing and Warning Sensor.
8) Ensure that the system, including the alerts cannot be bypassed or turned off by operator during equipment operation.