C-VIGIL Ltd : marine (CVM)

Marine Safety & Security Systems

GUARDIAN SYSTEMS

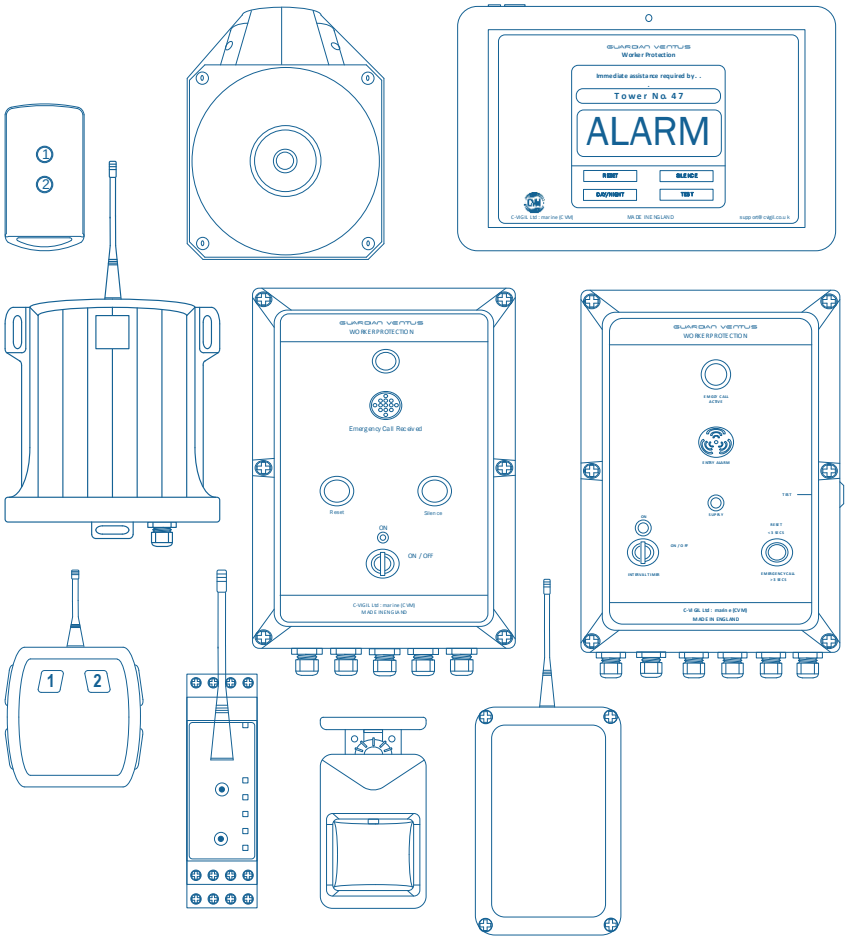
Portable Wireless Worker Protection

guardianVENTUS

Wind Turbines

GUARDIAN VENTUS

Operations Guide



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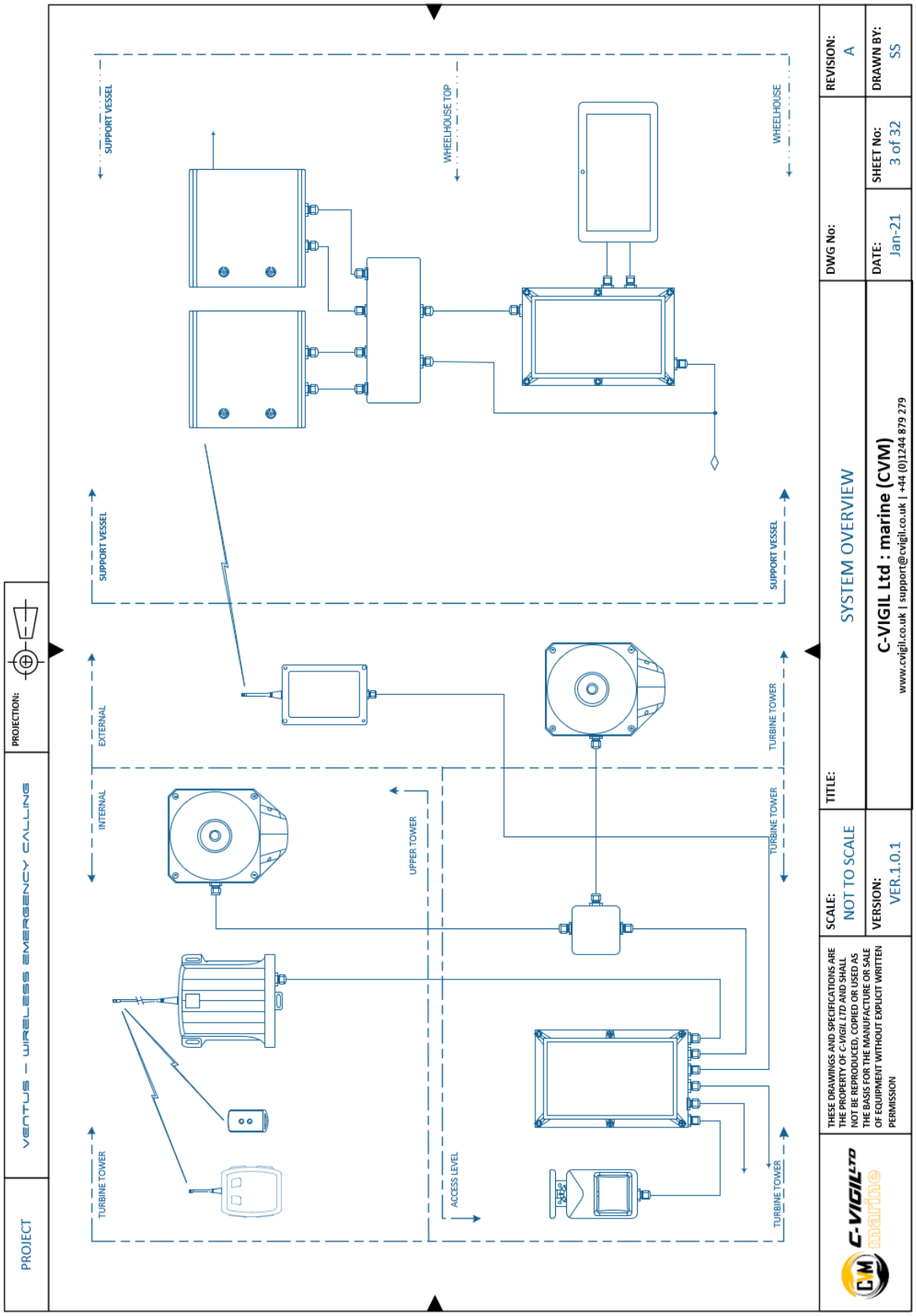
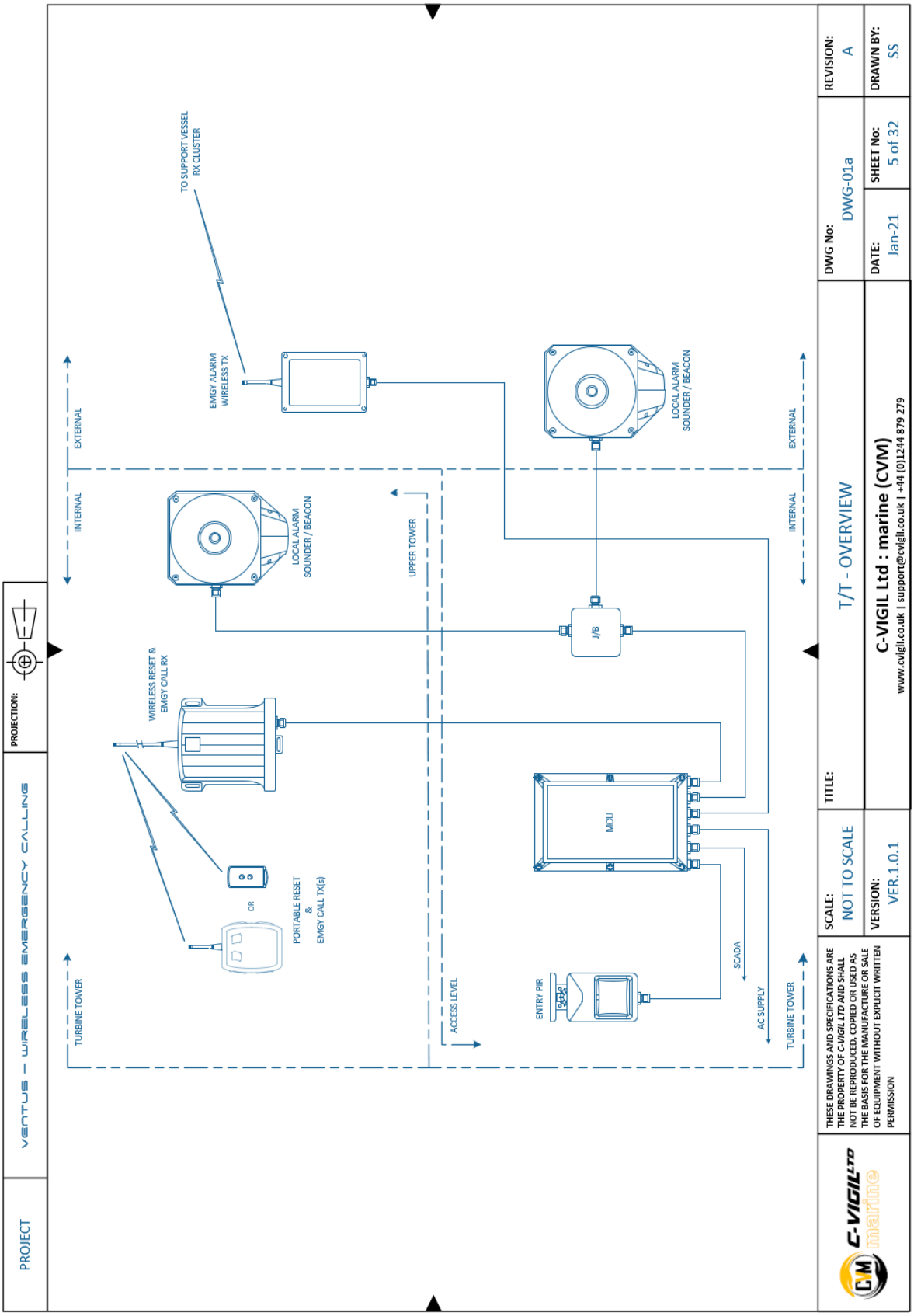
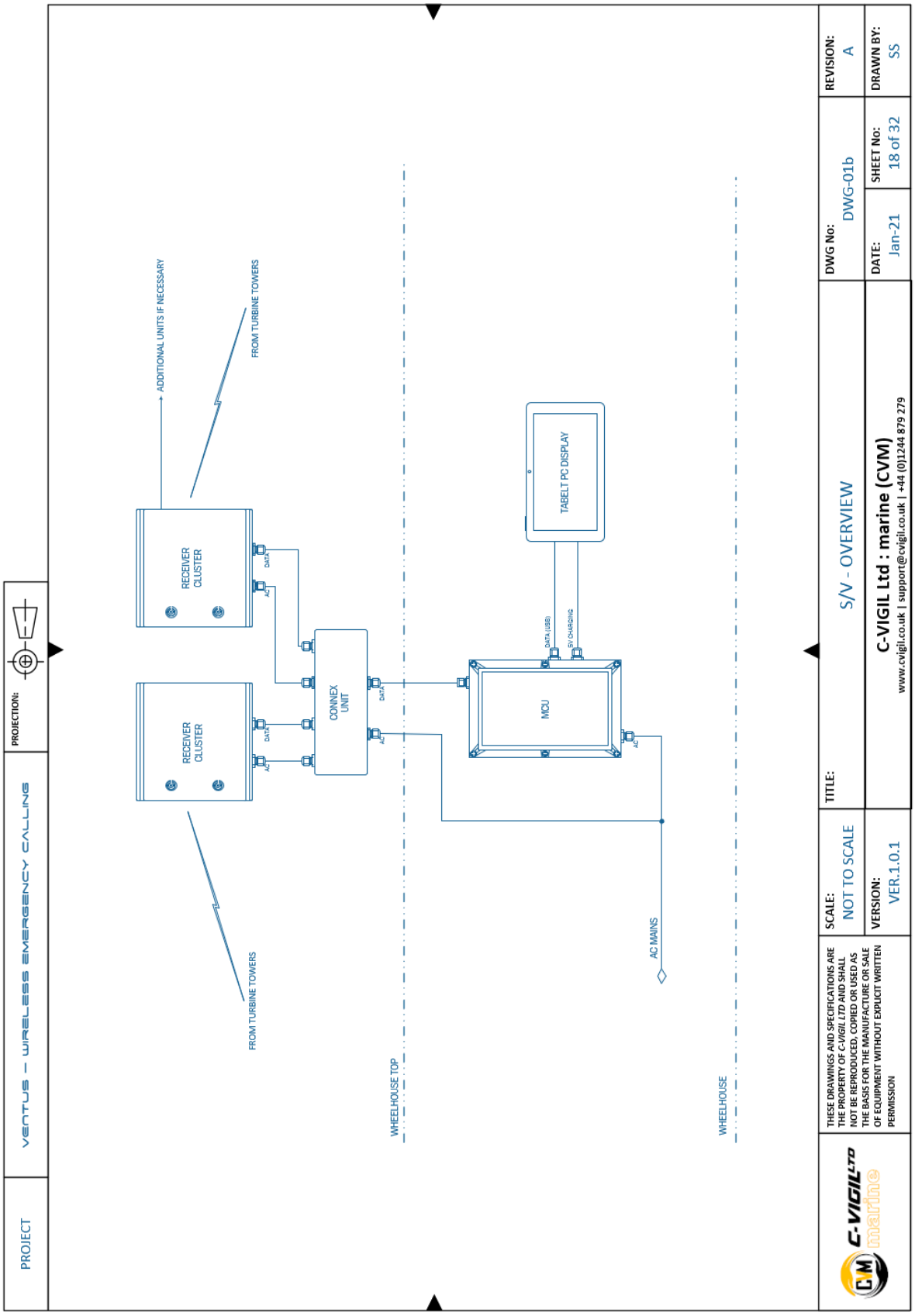


Turbine Tower Overview



Support Vessel Overview



1. General Description

Establishing a healthy and safe working environment for lone workers can be different from organizing the health and safety of other work staff - they should not be put at more risk than any other type of worker.

It will often be safe to work alone. However, managers should think about and deal with any health and safety risks **before** people are allowed to do so.

One option is to provide these service and maintenance workers with lone worker protection and emergency calling equipment; thereby improving the chances of a successful outcome should the worst happen.

Protection can be provided for: -

- Upper and lower tower areas
- Nacelle and machinery areas

VENTUS has been designed to supplement existing safety measures i.e., regular radio calls, to give added protection for maintenance and service workers attending turbine towers on regular intervals.

Offshore wind farm towers are, by their very nature isolated places to work, therefore should anything untoward happen to the attending workers it's crucial, for a successful outcome, that help is summoned immediately.

Remember – it's better to have it and not need it, then to need it and not have it!

Description

On entering the tower, a PIR motion sensor will detect the worker's presence and activate an 'entry' alarm on the MCU, located near the entrance hatch. This will draw the worker's attention to the MCU and the fact he/she must activate the lone worker system prior to proceeding.

The worker should then operate the key switch, which turns the 'entry' alarm off and starts the interval timer, for a period of 15 minutes. The worker should then radio the support vessel to expect a test 'Emergency Call Transmission' which should register the tower's number on the Alarm Indicator Display situated in the support vessel's wheelhouse.

Following confirmation, the worker can then remove the key (for safety's sake), collect the portable wireless reset/call transmitter, and proceed to their workplace.

With the interval timer running, the worker must use the portable wireless transmitter to reset the timer before the end of the 15-minute interval. The wireless reset can be used at any point.
At the end of the 15-minute interval the 1st Stage alarm is sounded through the local sounders, this warns the worker they haven't reset the system yet.
If, after a further 1 minute, no reset is received the 2nd Stage alarm is triggered. The local alarms continue to sound, and an 'Emergency Call' coded radio transmission is sent to the receiver aboard the support vessel, raising the alarm & giving the towers ident number.
The 'Emergency Call' transmission is repeated every 5 minutes till cancelled, which can only take place from the tower itself.

Manual 'Call for Assistance' is also available by pressing the reset button for more than 2.5 seconds – this then by-passes the timer and enters the staged alarms sequence immediately.

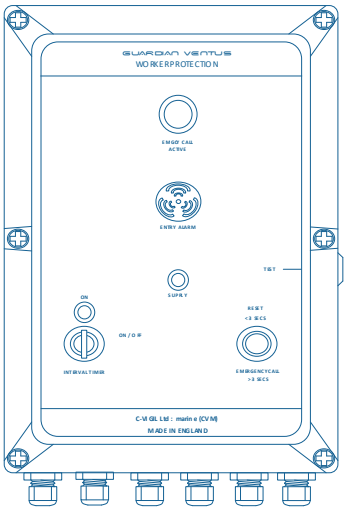
Wireless portable transmitter has button-2 programmed to sound the local alarms whilst pressed - to signal to co-workers, when needed.

Features

- Supplements any existing safety measures
- Worker entry detection
- 15-mins interval period
- Wireless portable reset/emergency call transmitter
- Emergency "Call for Assistance" to immediately signal help is required
- Emergency call radio transmission to support vessel

2. Turbine Tower - System Components

2.1 Main Control Unit (MCU)



MCU – fitted within the lower tower, adjacent to the access hatch, giving easy access to attending personnel.

The MCU contains: -

Entry-Alarm – pulsing 80dB sounder

Key-Switch – cancels entry alarm and activates interval timer.

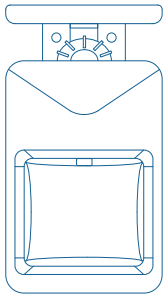
Reset / Call for Assistance – short press (<3 secs) resets interval period timer. Long press (>3 secs) Call for Assistance

Test – push button sends emergency call transmission to the support vessel, used on entry to ensure system in good working order, tests LED indicators

Power On – LED indicator

Emergency Call – LED active when emergency call transmitted

2.2 Entry PIR

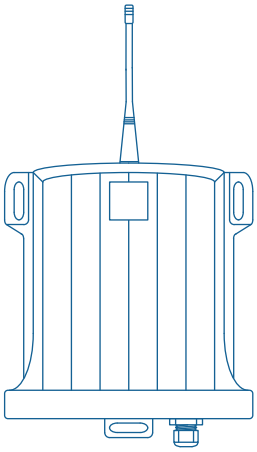


Directional PIR to be installed at the tower entrance area.

12m detection range

Variable pulse counts to prevent false alarms

2.3 Wx Reset/Call Receiver



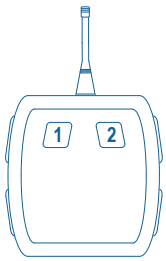
Wireless reset / emergency call receiver.

868MHz license free frequency

4 relay outputs – changeover contacts

IP65 enclosure

2.4 Wx Reset/Call Tx (Rugged)



Wireless reset / emergency call transmitter

868MHz license free frequency

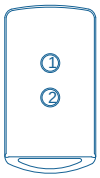
200m range

Button 1 – reset / call (press <3 secs)

Button 2 – Activate local sounders (press >3 secs)

IP65 enclosure

2.5 Wx Reset/Call Tx (Standard)



Wireless reset / emergency call transmitter

868MHz license free frequency

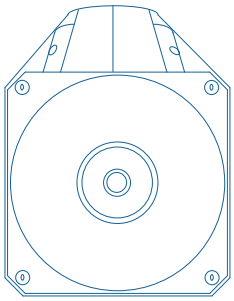
200m range

Button 1 – reset / call (press <3 secs)

Button 2 – Activate local sounders (press >3 secs)

IP65 enclosure

2.6 Local Alarm Sounder/Beacon



High output industrial sounder

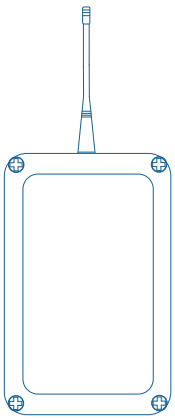
Multi-tone selection

116dB @ 1m

IP65

Alarm sounder for local signalling

2.7 Emergency Call Transmitter



LoRa (long range, low power) transceiver

IP67 enclosure

868Mhz 0r 915Mhz (N. America) license free frequency

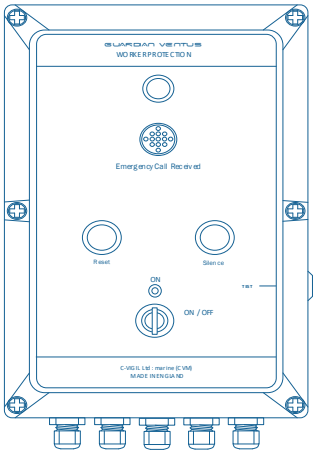
22Km operating distance

Activates unique relay on support vessel identifying turbine tower

Powered from MCU

3. Support Vessel - System Components

3.1 Main Control Unit (MCU)



MCU – connected to the radio relay modules (in receiver cluster) to indicate incoming emergency calls from any of the turbine towers.

Key Switch – power on with removeable key for safety.

Power On – LED power on indicator

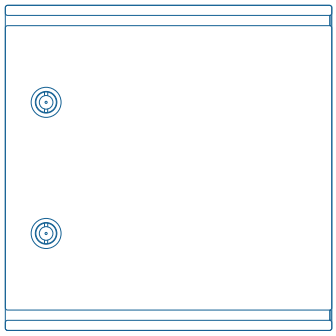
Alarm Sounder + LED – activates when incoming emergency call is received

Alarm Silence – silence emergency alarm sounder

Alarm Reset – once the tower's emergency call has been cancelled, the emergency alarm can be accepted / cancelled

Test – push button to test the LED alarm indicators.

3.2 LoRa Receiver Cluster



IP65 enclosure

Contains. . .

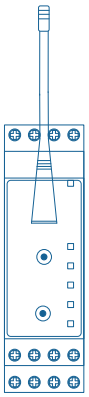
4ch radio relay modules (depends on number of towers being protected)

Processor and comms PCBs

AC vessel's mains from MCU / connex unit

Ethernet data connection to MCU via connex unit

3.3 LoRa 4ch Radio Relay Modules



LoRa (long range, low power) transceiver

4ch radio relay modules 1 to 25

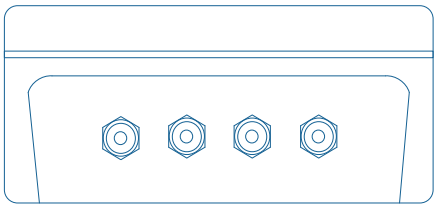
868Mhz or 915Mhz (N. America) licence free frequency

Individual towers operate one of the 4 relays

Connected to microprocessor PCB

DIN rail mounted

3.4 Relay Cluster Connex Unit



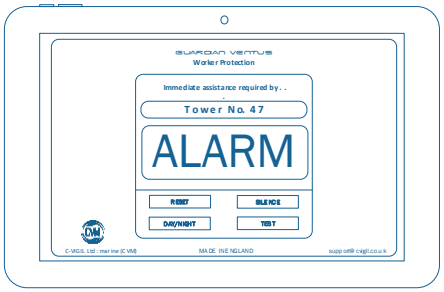
IP65 enclosure

Contains. . .

Supply protection fuses

5 port gigabit ethernet hub

3.5 Tablet PC Emergency Alarm Display



Displays number of towers requesting assistance

10.1” display

Windows 10 OS

Charges from MCU

Data from MCU over USB

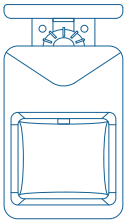
4. Turbine Tower System Functions

4.1 Power On

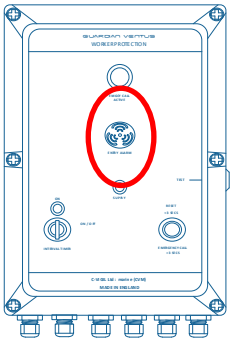
The MCU is powered permanently from the tower's own protected AC supply, a yellow LED indicates power is present.

4.2 Worker Entry Detection

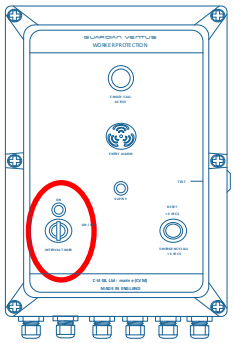
As attending worker(s) enters the tower a PIR motion sensor detects their presence.



On detection, an alarm is sounded on the MCU to draw the worker's attention to the MCU



At the MCU the worker should turn the key switch to a. cancel the entry alarm sounder and b. start the lone worker interval timer. The interval timer LED and the reset button LEDs indicate the timer is running.



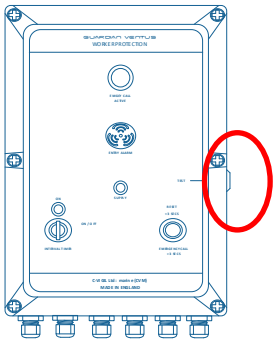
Once the interval timer is active it needs to be reset every 15min to prevent an emergency call being transmitted to the support vessel.

For safety, the key should then be removed and carried, along with the portable wireless reset / call transmitter.

4.3 Entry Test of Emergency Call Transmission

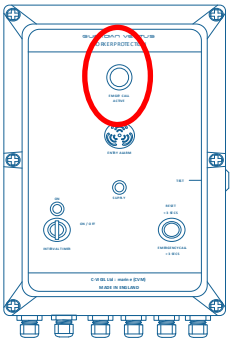
Before proceeding further, it is advisable to carry out a test of the 'Emergency Call' radio transmission to the support vessel.

Press and hold the 'TEST' button for >2.5 secs.



Once the LED – 'EMERGENCY CALL ACTIVE' – is illuminated the button can be released, a test transmission will be sent by the emergency call transmission unit on the tower to the support vessel.

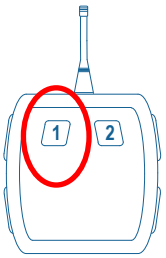
Acknowledgement can be confirmed with the support vessel.



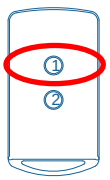
4.4 Worker's Portable Wireless Reset / Call Tx

Before proceeding the worker should collect the portable transmitter (whichever one has been provided) and keep it with them till their work is complete and they exit the tower.

Button functions: -



Rugged

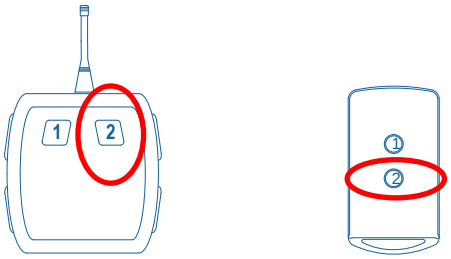


Standard

Button 1: -

- Short Press (< 2.5 seconds) – reset interval timer to zero, cancel all staged alarms

- Long Press (> 2.5 seconds – bypass interval timer and immediately activate ALL alarm stages, including emergency call transmission to support vessel.



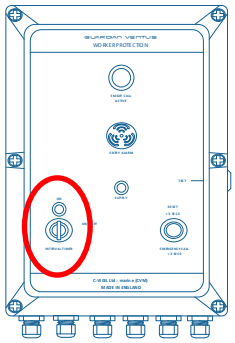
Rugged Standard

Button 2: -

- Activates local alarm sounder / beacons whilst pressed

NB. The reset button can be pressed at any time, preferably before the interval timer completes

4.5 Interval Timer On – 15 mins



- On: -

  Turn the key to the on – off position.

  The timer on and reset button LEDs will illuminate to indicate the timer has started.

  Allow the key to return to the upright position.

  For safety reasons remove the key and keep with you till the work is complete

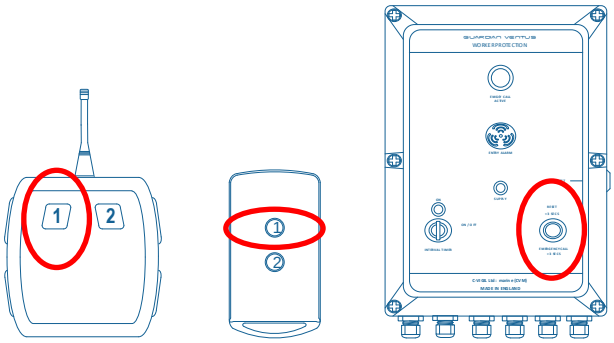
- Off: -

  Turn the key switch to the on – off position and hold there till the LEDs are extinguished – approx. 2.5 seconds.

  You now have 2.5 minutes to vacate the tower before the entry PIR movement sensor is reactivated.

4.6 Interval Timer - Reset

The interval timer can be reset anytime during the 15-minute period, by a short press (<2.5 secs) of button 1 or by using the reset button on the MCU.
The reset button will also cancel the staged alarms if active.

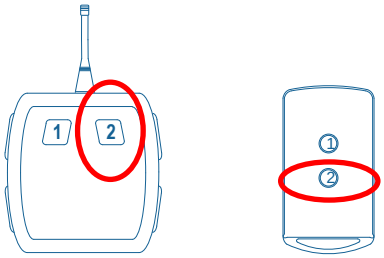


4.7 Emergency Call for Assistance

If a situation arises where assistance is required immediately and don't want to wait for the interval timer to complete, you can use the same buttons as in 4.5 above, holding the buttons down for > 2.5 secs will bypass the timer and enter 2nd staged alarm phase immediately.

4.8 Local Signalling

The local sounder / beacons can be controlled using button 2 on the wireless portable transmitters.
The alarms will sound for as long as button 2 is pressed.



4.9 Leaving Tower – Timer Off

Turn key to on – off position and hold for at least 2.5 seconds, timer on and reset button LEDs will extinguish.

5. Staged Alarms

5.1 Interval Time : T = 0 mins

- Interval time expires : T = 0 mins
    - Main local alarm sounder / beacons – Beacon only (1st STAGE)
    - MCU entry alarm - ON

5.2 Interval Time : T = T + 1 mins

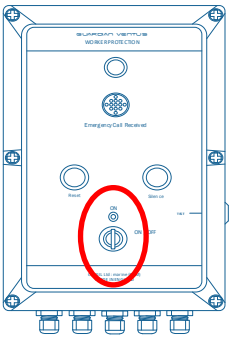
- Interval time : T = T + 1 mins
    - Main local alarm sounder / beacons – Beacon + Sounder (2nd STAGE)
    - MCU entry alarm - ON
    - Emergency radio call - ACTIVE (2 secs every 5 mins)

5.3 Interval Time : Reset

- Interval time : T = 15 mins
    - Local alarm sounder / beacons – OFF (1st STAGE & 2nd STAGE Reset)
    - MCU entry alarm - OFF
    - Emergency radio call - OFF

6. Support Vessel Functions

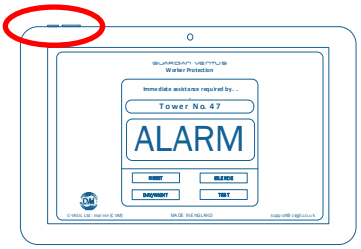
6.1 MCU - Power On



The MCU is fitted with a key operated power on switch, so once powered up the key can be removed to prevent any accidental or unauthorised disconnection whilst workers are on the towers.

On initial turn on the sounder is pulsed for 0.5 secs to indicate the plc module has started correctly. Once turned on the yellow supply LED will illuminate.

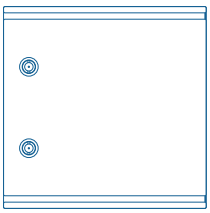
6.2 Tablet PC Display – Power On



Press and hold the tablet's on button till the screen comes to life.
After a short period, windows 10 OS loads.
After a further period, the VENTUS display app will load automatically. If, for any reason, it doesn't - double click the VENTUS icon on the tablet's desktop.

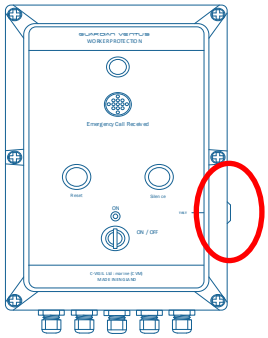
The tablet is powered / charged from a 5V DC USB charger in the MCU

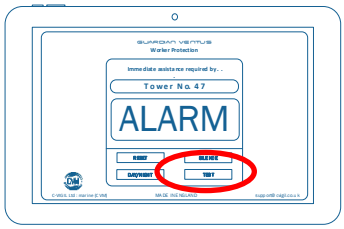
6.3 Receiver Cluster(s) - Power On



The receiver cluster(s) are fed directly from the MCU protected supply via the Connex Unit.

6.4 MCU Initial Test





To ensure everything is still in good order, it is advisable to test the sounder and indicators.

Press the MCU's test push button or the display's software button once to begin the test, press again to cancel.

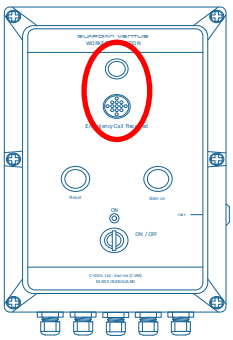
During the test period, the MCU's Emergency Call Active LED and sounder are activated plus the display's text inputs.

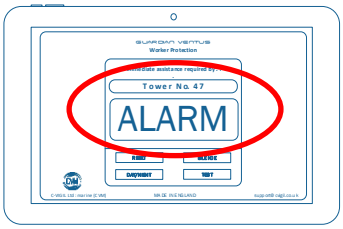
6.5 Emergency Call Reception

In the event of an emergency call being transmitted from a tower, the relevant radio-controlled relay in the receiver cluster will operate sending a closing signal to the microprocessor PCB. The microprocessor identifies the relay and sends a data packet with the associated tower's ident to the ethernet hub in the connex unit.

The ethernet hub is hard wired to the comms/processor PCBs in the MCU. The data is again processed, and the tower's ident info is passed on to the display.

Alarm indication is displayed on the tablet and the MCU.

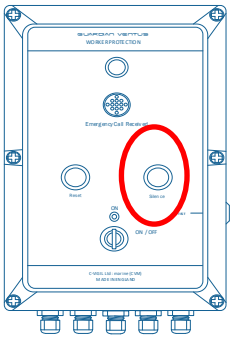


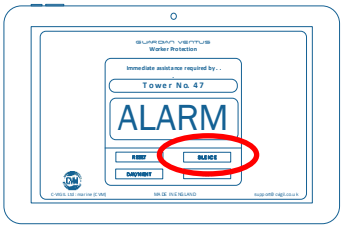


6.6 Emergency Alarm - Silence

The sounder can be silenced by either pressing the push button on the MCU or the software button on the tablet PC display.

The sounder will be activated every time an emergency call is received. This can be every 5 mins as the emergency transmission from the tower repeats every 5 mins. This is to ensure the call is not missed.





6.7 Emergency Alarm - Reset

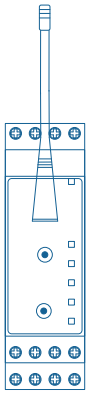
Once the emergency has been resolved and the emergency call transmission reset – at the tower – the alarm panel indicators and display can then be reset. Pressing the alarm reset push button or the display software button for 2.5 seconds will cancel all the alarm indications.

7. Support Vessel Receiver Cluster(s)

7.1 LoRa Radio 4ch Relay Transceiver Modules

The receiver clusters link the towers wirelessly to the support vessel. The LoRa transceivers on the tower and support vessel give a line-of-sight range of around 22km.

Each receiver cluster holds up to 25 radio controlled 4ch relay modules.



Each relay channel is programmed / paired to an emergency transmission unit of an individual tower i.e., one tower one relay.

The relay N/O contact is wired to an GPIO (general purpose input output) pin of the microprocessor, which has 50+ pins.

The microprocessor has an ethernet PCB piggy-backed to the board.
Pre-programmed data is allocated to each GPIO pin, so that a data packet containing the tower's ident is sent when the relay operates.