MFD Screenshot

NVD LCD Bullseye Screenshot
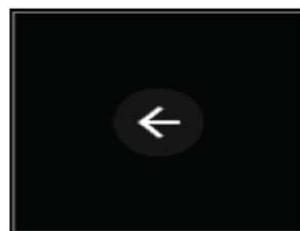
5.3.2   Types of Remote Objects

Types	CxS Devices	Icon	Examples
Heavy Vehicle	• 1xNVD • 1xCAN Isolator • 4x to 6x PRSs		LHD, Haul Truck, Grader, Boom Truck, Drills, Scaler, etc.
Light Vehicle	• 1x NVD • 1x to 2x PRSs		Pickup, Side-by-side, Golf Carts, etc.

| Types	CxS Devices	Icon	Examples
Pedestrian (Not yet released)	NPD-L1x NPD		Any personnel going underground.
Environment (Not yet released)	CxS-enabled FHB		Void, Water Sump Pump, Open Brow, etc.

5.3.3 Telemetry Input

The parameters that are currently supported to show on the MFD are:

- Current Speed
- Current Gear
- Current Direction
- Slope
- Payload

Note!   *These input parameters can be provided by either Newtrax OEM-agnostic telemetry solution (MET) or by leveraging the sensors linked to the Vehicle Intervention Controller, if ISO21815-2 compatible devices are already deployed on the vehicle.*
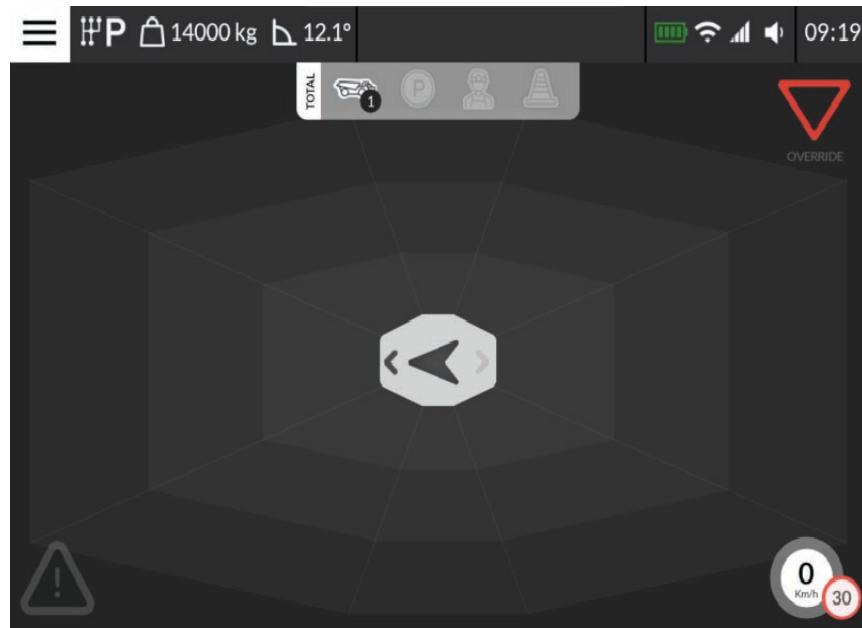
When the Forward or Reverse gear is activated, the screen pins and the top bar disappears.
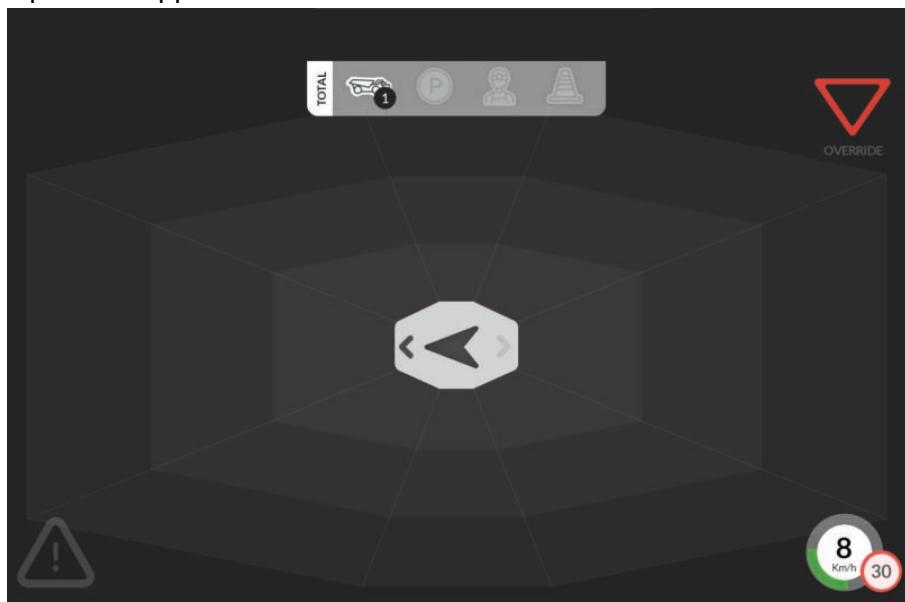
When the gear is changed to Parked, the screen unpins and the top bar reappears.
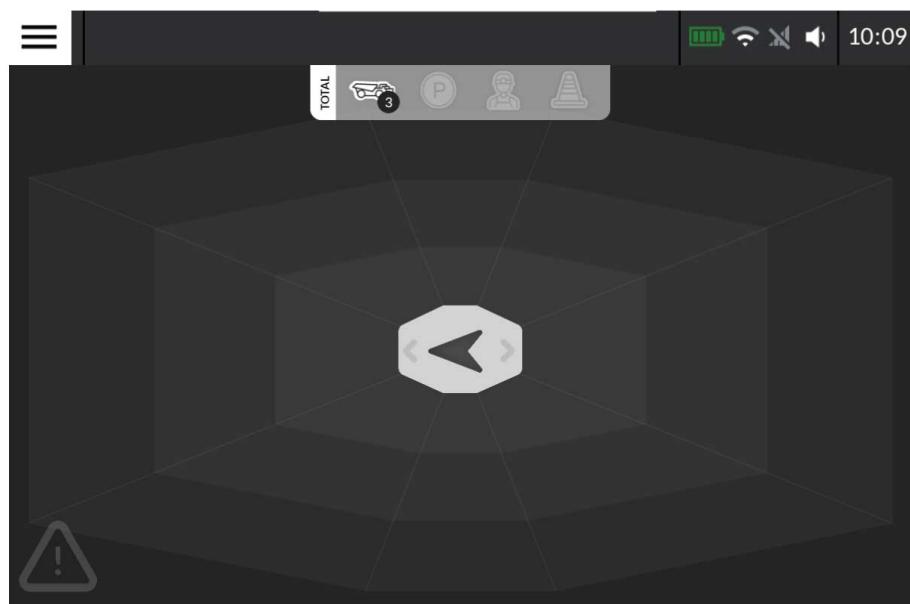
Note!   ***Different telemetry sources might use different methods to determine if the vehicle is parked.***
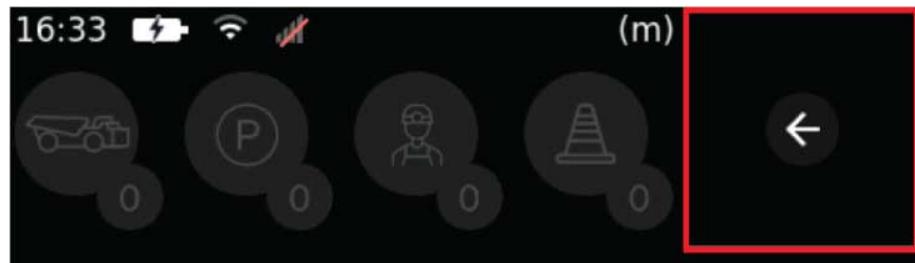

5.3.4   Sectors

The NVD LCD and NVD Android UI Bullseye are separated into 8 sectors. Based on the 2D coordinates of the RO calculated by the NVD, it will be placed into one of these 8 sectors.

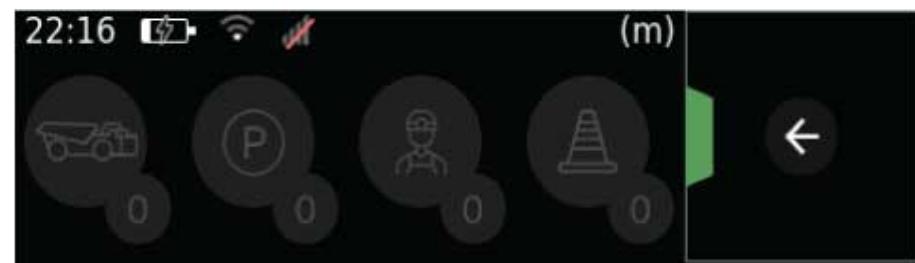*Note!*   ***The boundaries of the sectors are not shown on the NVD Bullseye.***

Currently, the RO will either be placed in the detected sector if the system has great confidence in its location or be shown in all sectors if the direction cannot be positively identified with a good level of confidence. Refer to the images below for examples.

RO placed in the detected sector:

RO is placed in all sectors:

5.3.5   Zones

⚠ WARNING	
	RISK OF COLLISION! **If a valid alarm indication is ignored, it puts people and vehicles in the area at risk of a collision that could result in death or severe injury.** **Make sure that you follow the standard procedures.**

5.3.5.1 Static Zones

<table>
<tr><td colspan="2" align="center">⚠ WARNING</td></tr>
<tr>
<td></td>
<td>

RISK OF COLLISION!

If the CxS system is used without proper zone definitions, this could lead to a collision that could result in death or severe injury. Zone definitions are to be carefully planned and determined using the characteristics of the vehicle and considering the characteristics of the site.

The operator must be aware of the size of the zones. Refer to vehicles documentation to obtain the information needed to define the zones. For example, the size of the front and rear zones of a loader must be similar since the maximum speed and braking performance are similar in both directions. Mine safety working procedures must be followed.

</td>
</tr>
</table>

The 8 sectors around an LO are each separated into 3 zones that are based on the distance from the envelope of the vehicle (vehicle outermost perimeter). The size of the zones is static and adapted to each model.

Their sizes depend on the following factors:

- Maximum speed
- Current gear
- Braking performance of the vehicle
- Desired stop gap.
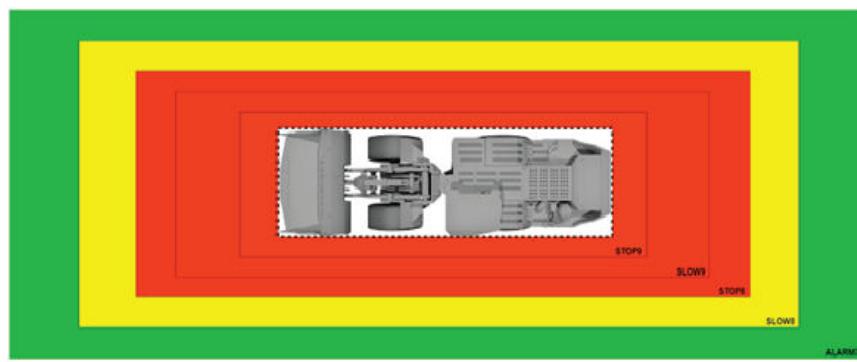
A truck rear zone will be much shorter because it drives much slower in reverse. The side zones are narrower, reflecting the required separation for RO in passing scenarios.

<table>
<tr><td colspan="4" align="center">Zones and Actions</td></tr>
<tr>
<th>Name of the Zone</th>
<th>LED Color</th>
<th>Name of Action</th>
<th>Description</th>
</tr>
<tr>
<td>Caution</td>
<td>Green</td>
<td>Warning</td>
<td>No Action</td>
</tr>
<tr>
<td>Alarm</td>
<td>Yellow</td>
<td>Slowdown Notification</td>
<td>Audible and Visible Slowdown Notification on UI</td>
</tr>
</table>

Zones and Actions			
Name of the Zone	LED Color	Name of Action	Description
Danger	Red	Stop Notification	Audible and Visible Stop Notification on UI
Danger	Red	Slowdown Intervention	Vehicle intervention: Controlled slowdown to derated speed (e.g., limiting to first gear)
Danger	Red	Stop Intervention	Vehicle intervention: Controlled stop

5.3.5.2   Dynamic Zone

> ## ⚠ WARNING
>
> **RISK OF COLLISION!**
>
> **If the CxS system is used without proper zone definitions, this could lead to a collision that could result in death or severe injury. Zone definitions are to be carefully planned and determined using the characteristics of the vehicle and considering the characteristics of the site.**
>
> **The operator must be aware of the size of the zones. Refer to vehicles documentation to obtain the information needed to define the zones. For example, the size of the front and rear zones of a loader must be similar since the maximum speed and braking performance are similar in both directions. Mine safety working procedures must be followed.**

Note!

The capability of the dynamic zones entirely depends on the telemetry inputs and vehicle dynamics (braking parameters). If the link with the telemetry input(s) is broken, the CxS application will default back to static zones.

If the telemetry input is the VIC and the communication is lost, there will be a VIC Wired Link Lost notification. If there is an MRU, this will be used as a fallback for telemetry. If not, the system will revert to static zones. However, if the sole telemetry input is the MRU, there is currently no indication of a lost link for the operator.

When the equipment is stationary, the zones are reduced to a safe minimum in the possible directions of travel, which depend on the configured stop gap and safety factors. Only the ALARM7 zone is maintained to its configured minimum size to maintain visibility around the equipment for the operator.
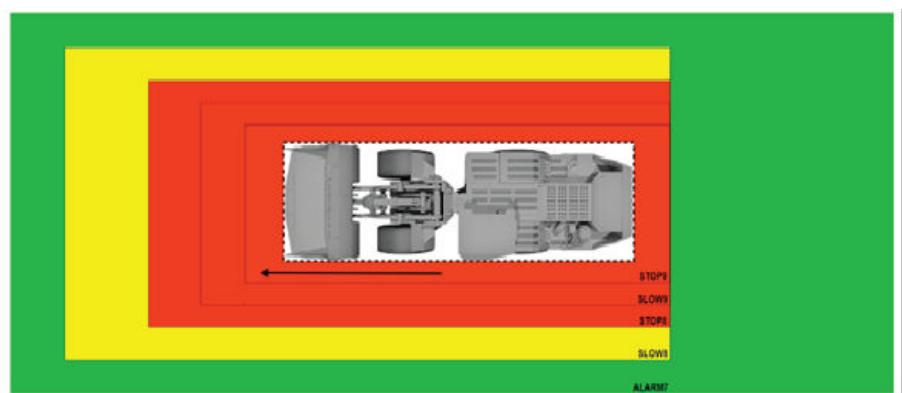
The size of the side zones remains constant regardless of speed or direction.
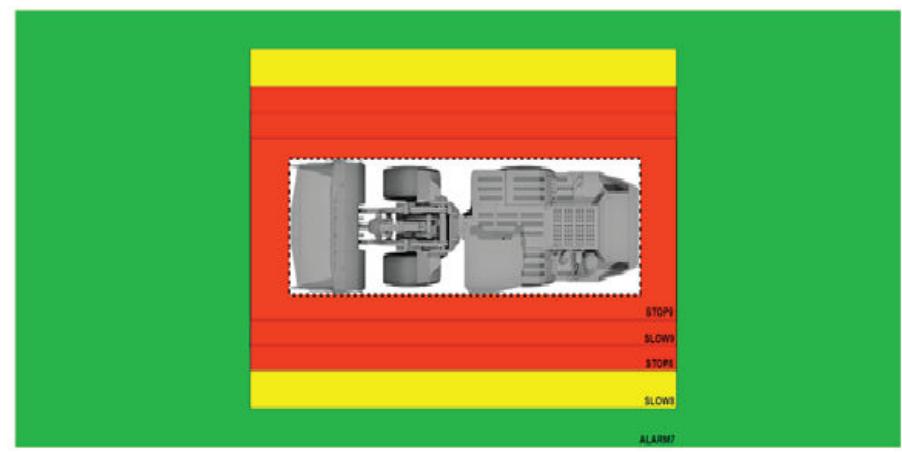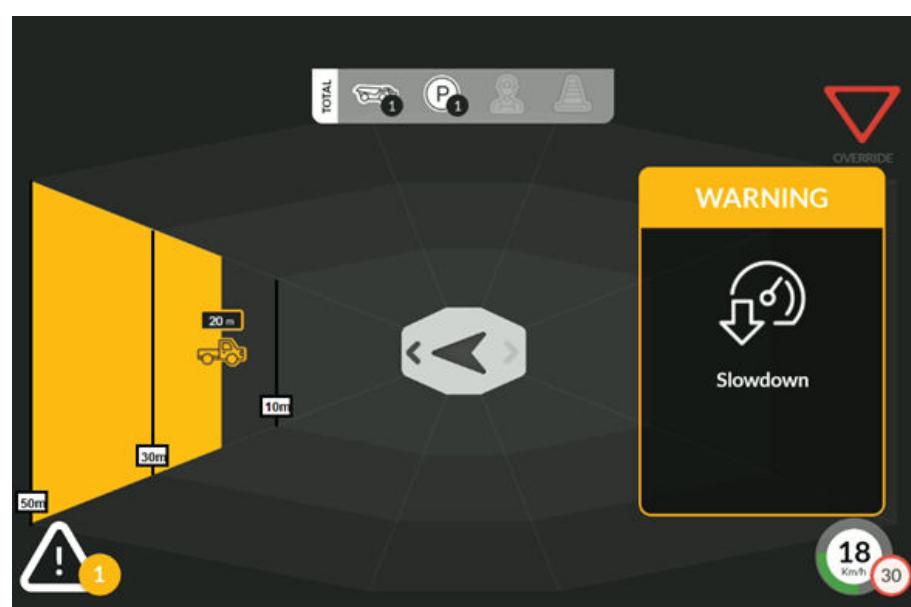
When the equipment starts moving from standstill, the zones modulate using two variables:

- Speed: Indicates the magnitude of the zones expansion

- Direction: Indicates the direction in which the zones expand and remains the same in the opposite direction of travel.

5.3.5.3   Zone Fill

When a remote object moves into a zone, the color is proportionally filled in this zone and the zones of lesser priority, if applicable. When the distance threshold of the next zone is reached, the color fill will change.

For example, if the zones are configured as follows: Caution at 50m, Alarm at 30m, Danger at 10m, and the RO is positioned by the system at 20m, which is halfway into the Alarm zone, the latter will be filled by 50%.

5.3.5.4   Caution Zone

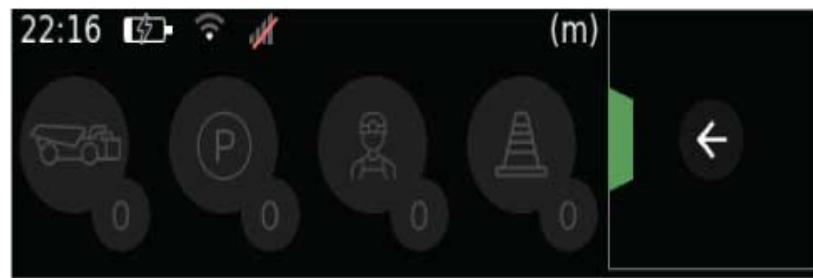| ⚠️ **WARNING** |
|---|
| **RISK OF COLLISION!**

Over-reliance on the system may lead to a collision that could result in death or severe injury. The operator must be aware of his surroundings.

The operator must not solely rely on the Bullseye to identify mobile or fixed hazards. Pedestrians, vehicles, or fixed hazards could still be within the Caution Zone, regardless of what the Bullseye indicates. |

The Proximity Ranging Sensors (PRS) LEDs begin to flash green color at a low frequency when a Remote Object (RO) enters the Caution Zone.

The furthest zone from the Local Object (LO) is the Caution Zone, which is filled in green in accordance with the fill ratio described in the section Zone Fill. This zone displays caution to the operator about a remote object in the vicinity.
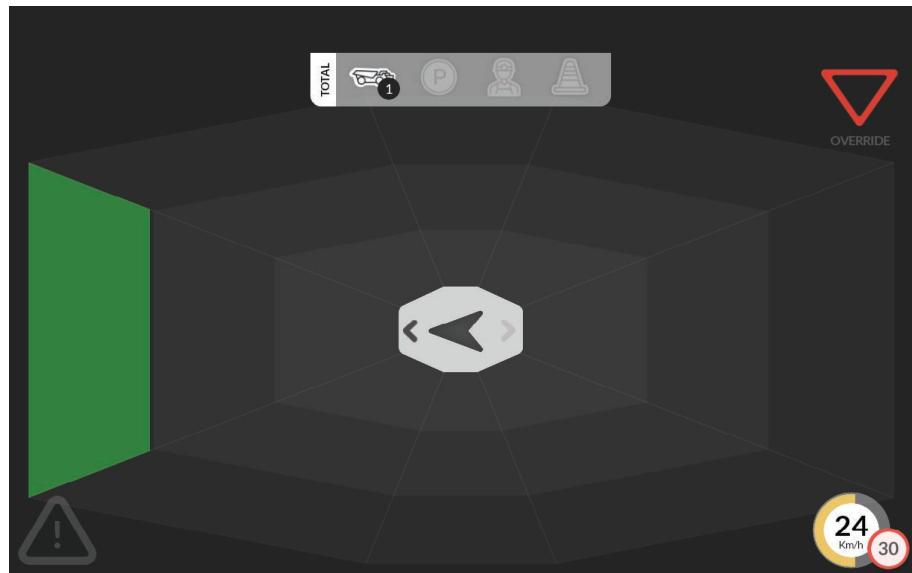
Note!   *Similarly, the NVD CxS Bullseye shows the sector filling in green from the same direction and based on the same fill ratio, but it will not show the icon of the vehicle type on the bullseye.*

5.3.5.5 Alarm Zone
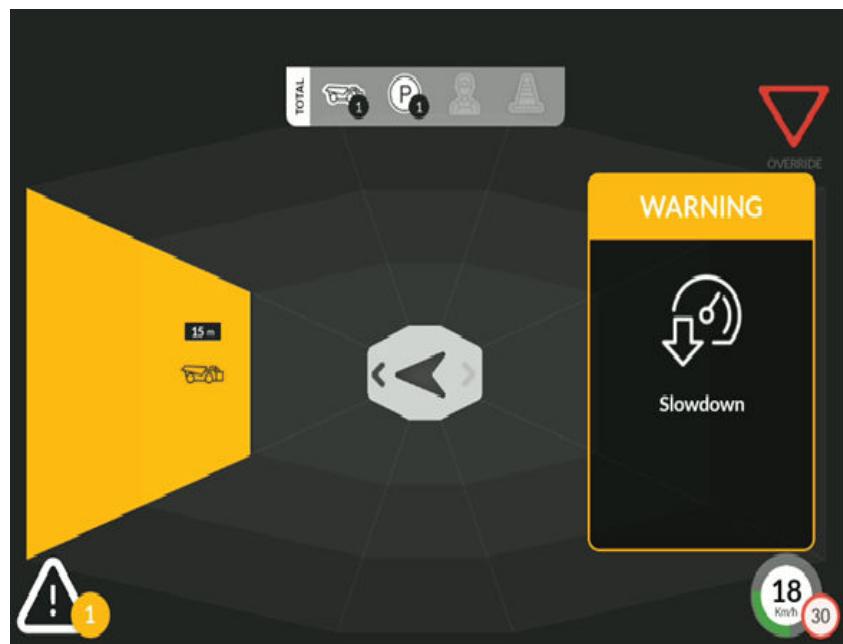
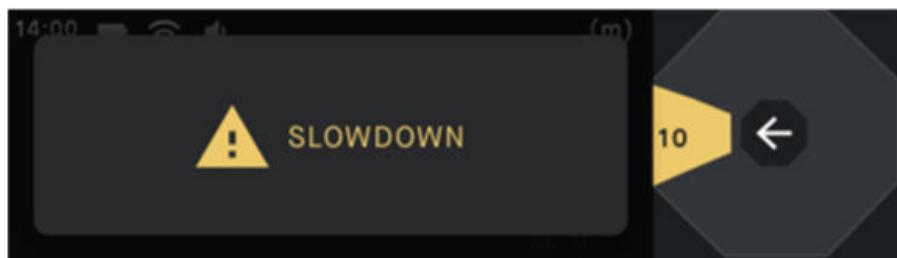|	
⚠️	**⚠ WARNING**
	RISK OF COLLISION! **Over-reliance on the system may lead to a collision that could result in death or severe injury. The operator must be aware of his surroundings.** **The operator must not solely rely on the Slowdown notification to reduce the speed of the vehicle. Pedestrians, vehicles, or fixed hazards could still be in the Alarm zone, regardless of the state of the notification.**

The Proximity Ranging Sensors (PRS) LEDs begin to flash yellow color at a medium frequency when a Remote Object (RO) enters the Alarm Zone.

The furthest zone from the Local Object (LO) (Caution) will be filled in yellow color and the second furthest zone will be partially filled in a yellow color, based on the fill ratio. Simultaneously, the Multi-Function Display (MFD) will display a **Slowdown** notification and a text to speech **Slowdown** audio alert will be played every 2 seconds interval, as long as the RO is in the Alarm zone.

Similarly, the NVD CxS Bullseye shows the sector filling in yellow from the same direction and based on the same fill ratio. It shows the distance from the vehicle (either m or ft) rather than the RO type. It will also prompt a **Slowdown** notification.

5.3.5.6   Danger Zone

⚠ WARNING	
	RISK OF COLLISION! **Over-reliance on the system may lead to a collision that could result in death or severe injury. The operator must be aware of his surroundings.** **The operator must not solely rely on the Stop notification to immobilize the vehicle. The operator must also not solely rely on vehicle interventions to slowdown or stop the vehicle. Pedestrians, vehicles, or fixed hazards could still be in the Danger Zone, regardless of the notification.**

⚠ WARNING	
	RISK OF COLLISION! **If the Collision Warning/Avoidance System (CxS) is used without proper configuration, this could lead to a collision that could result in death or severe injury. CxS must be enabled only after proper commissioning.** **Care must be taken to define a proper CxS configuration.**

The Proximity Ranging Sensors (PRS) LEDs begin to flash red color when a Remote Object (RO) enters the Danger Zone.

The first two furthest zones from the Local Object (LO) (Caution and Alarm) of the sector the RO is in, will be filled in red, and the closest zone from the LO will be partially filled in red, based on the fill ratio. Simultaneously, the Multi-Function Display (MFD) displays a **Stop** notification and a text to speech **Stop** audio alert is played every 2 seconds if the RO is in the Danger Zone.

If Collision Avoidance System (CAS) is enabled, two additional distance-based actions are triggered by the system after the request for action notification is displayed on the tablet:

1. The **Slowdown** command is sent to the Vehicle Intervention Controller (VIC) for vehicle intervention once the RO is detected within the configured Slowdown Intervention threshold.

Note! ***The Slowdown settings will vary based on braking performance, current speed, and site requirements such as minimum follow gap and stop gap.***

2. The **Stop** command is sent to the VIC for vehicle intervention once the RO is detected within the configured Stop Intervention threshold.

Note! ***The Stop settings will vary based on braking performance, current speed, and site requirements such as minimum follow gap and stop gap.***
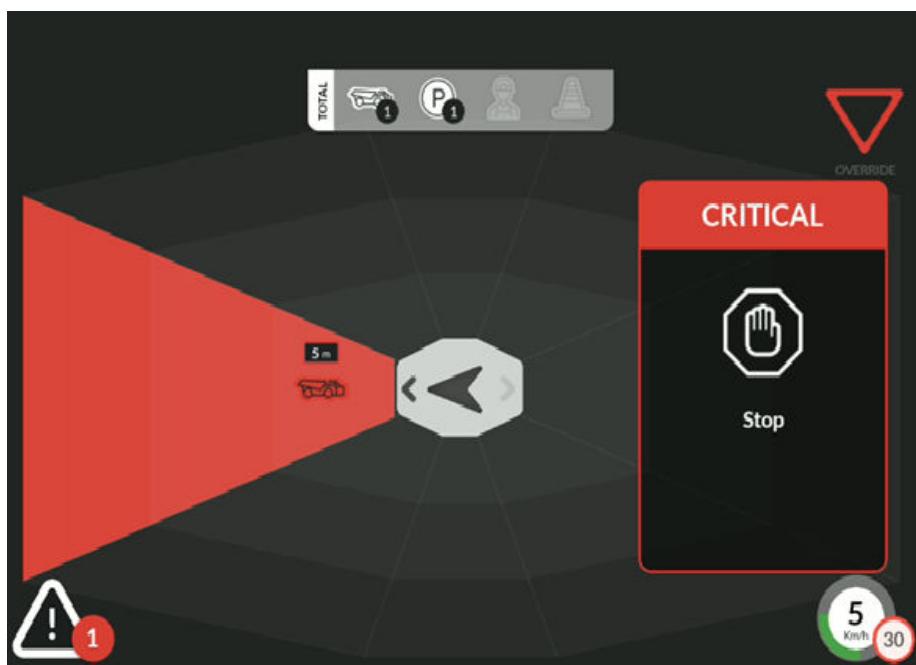

Similarly, the NVD CxS Bullseye shows the sector filling in red from the same direction and based on the same fill ratio. It shows the distance from the vehicle (either m or ft) rather than the RO type. It will also prompt a **Stop** notification.
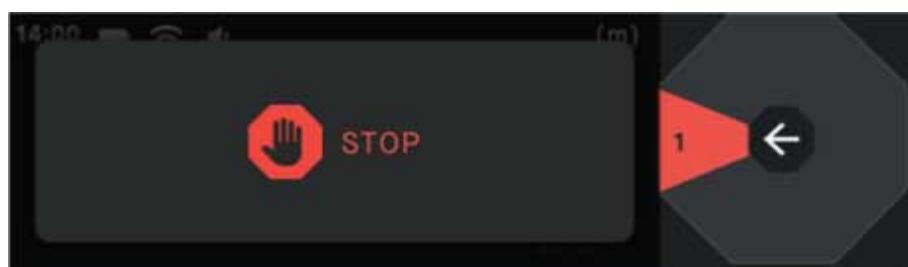
5.3.5.7 Multiple ROs in the Same Sector

1. If there is more than one RO in one of the sectors, the sector will be filled with the highest priority occupied zone. For example, if there is RO in the Alarm Zone and another RO in the Danger zone, you can see both icons are in their respective zones of the sector, but they will be filled in red color.
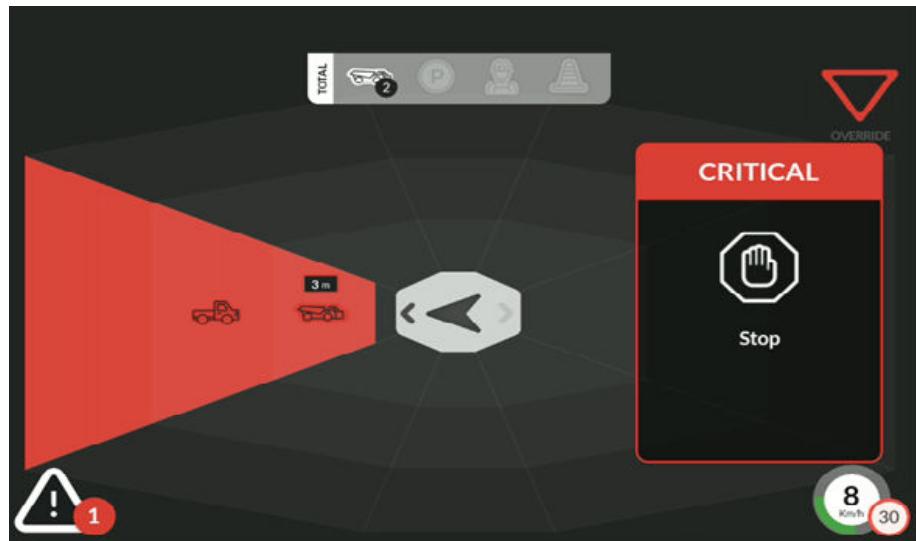
a. In the same situation as mentioned in step 1, the NVD will show the zone and the distance of the nearest remote object of the sector, with no indication on the Bullseye of the presence of a 2nd RO.
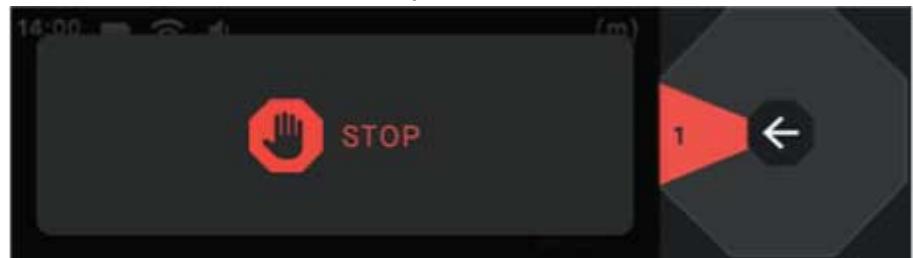
2. For more than one RO of the same type (refer to *Types of Remote Objects (Page 45)*) in the same zone of the same sector, there will be a count indicated next to the RO type icon.
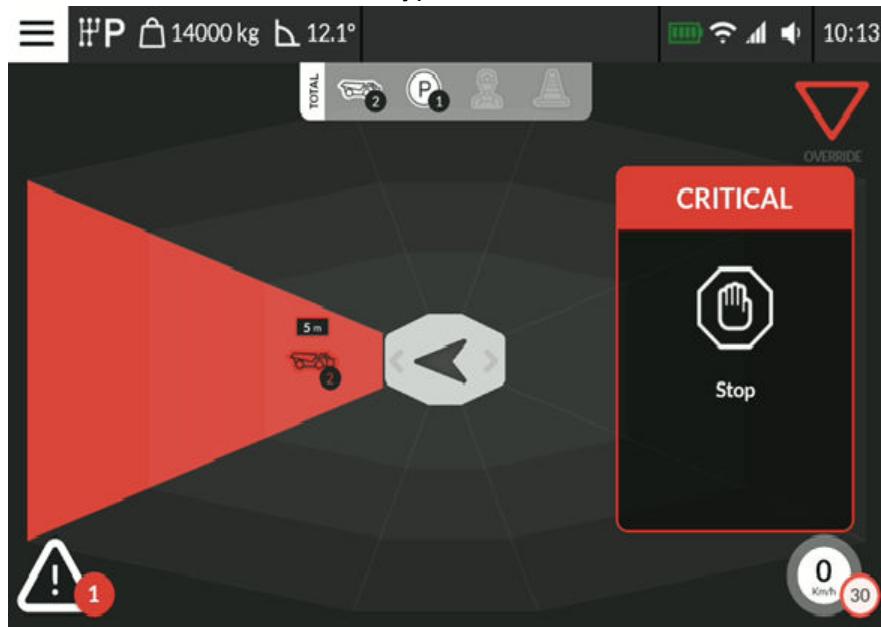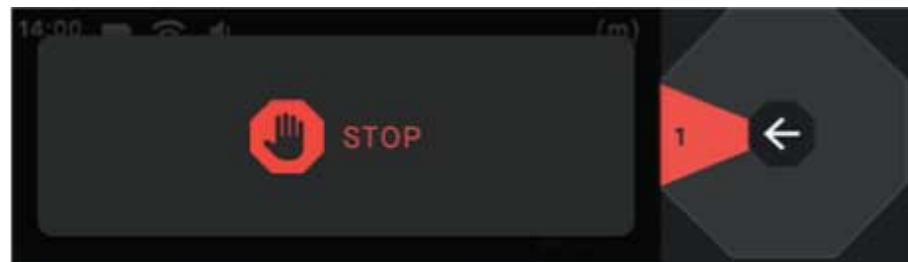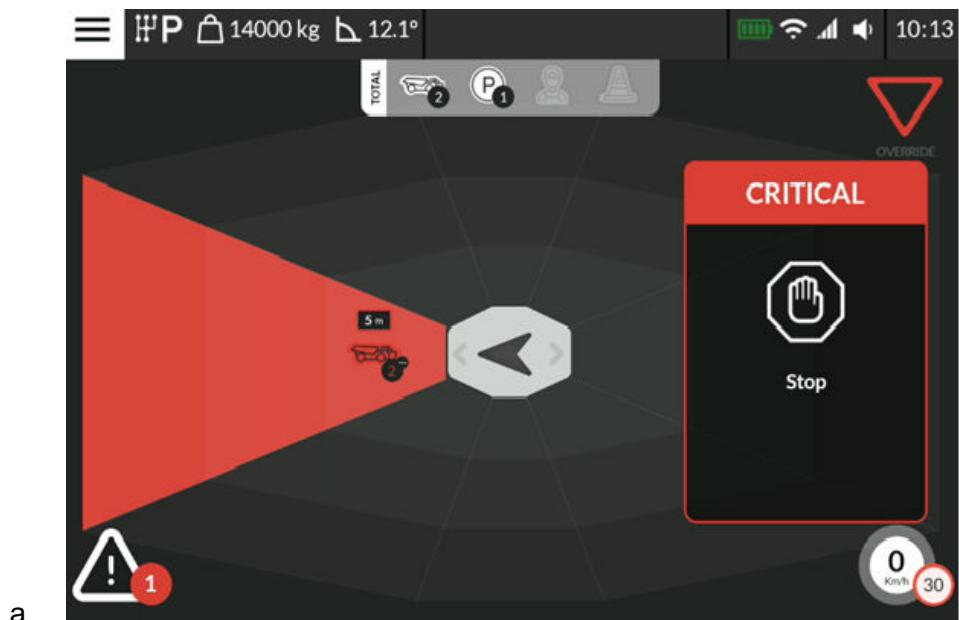

a. In the same situation as mentioned in step 2, the NVD will show the zone and the distance of the nearest remote object in the sector.

3. For more than one RO of a different type in the same zone of the same sector, the **"…"** modifier is shown on the icon, which indicates that there is more than 1 type of RO in addition to the existing ROs. The vehicle type icon shown will be in the order of vulnerability:

- Pedestrian
- LV
- HV
- FHB

a.

In the same situation, as described in step 3, the NVD will show the zone and the distance of the nearest remote object in the sector.
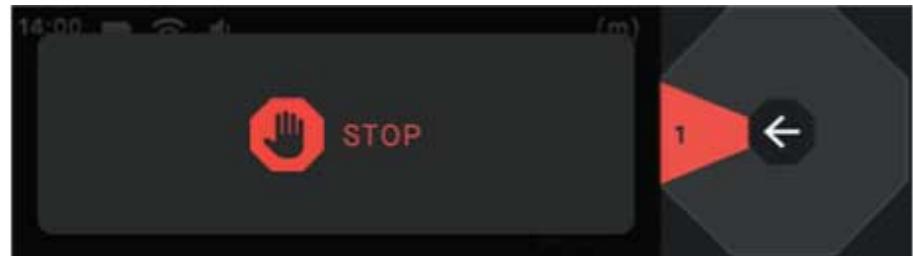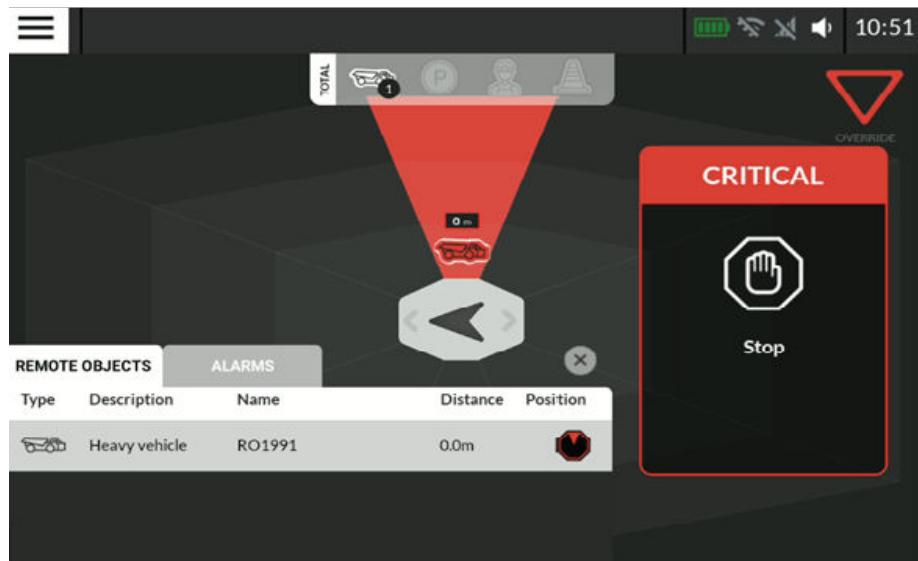

5.3.6   RO List (MFD Only)

Note!   ***Check the RO list when you are sure that you stopped the vehicle in a safe manner.***

Touch the RO icon to open the list of Remote Objects in the surroundings. The figure shows the following:

- Type of RO
- Description
- Vehicle ID or Mobile ID
- Distance from the RO
- Icon showing sector and zone.

5.3.7 Local Override (MFD Only)

⚠ **WARNING**	
	RISK OF COLLISION! **Incorrect assessment of the Remote Object (RO) by an operator can lead to a collision that could result in death or severe injury.** **The operator must understand the risks associated with using the Override Button and be responsible for correctly assessing that the Remote Object is in a safe location. The override settings, such as the Maximum Override Time, must only be modified by approved personnel.**

Note!   *Collision Avoidance System (CAS) only feature.*

The Local Override limits the vehicle intervention to a controlled Slowdown, which in turn limits the speed of the vehicle to the set slowdown speed.
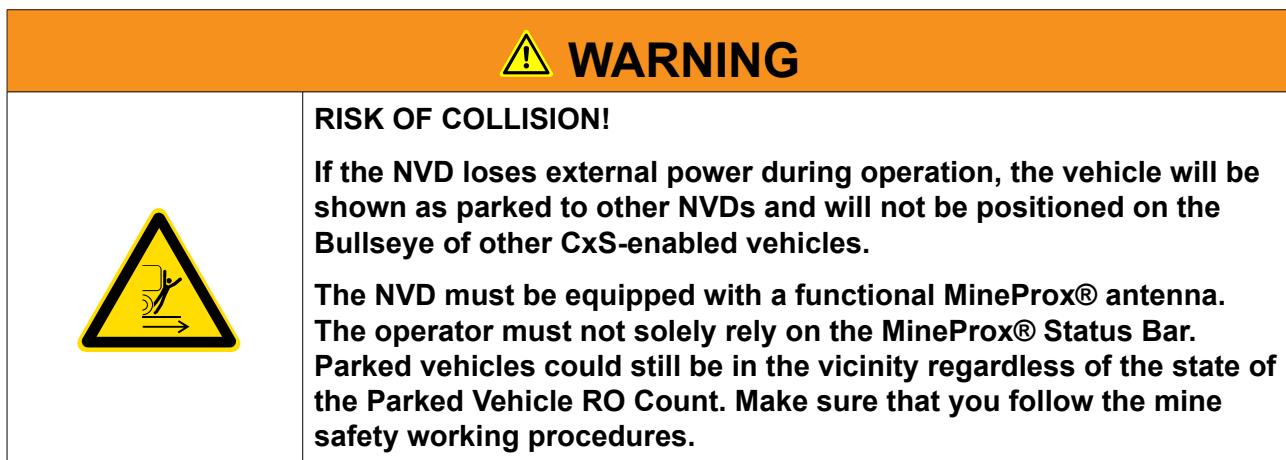
The figure below shows a loader operator that uses the Override button to approach a heavy vehicle, for example, a loaded truck.
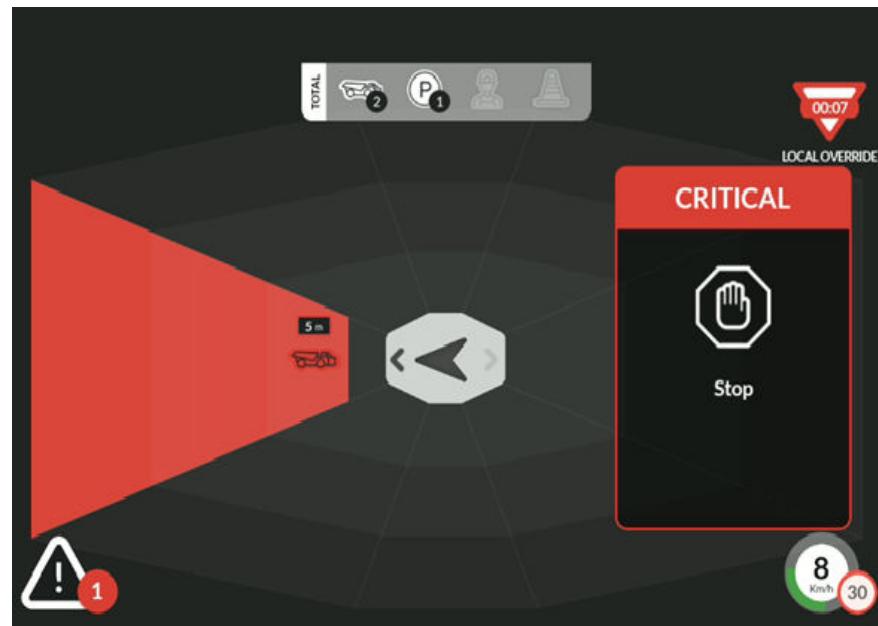
The figure below shows a Haul Truck that needs to pass a Light Vehicle, for example, one that is backed up in a muck bay.
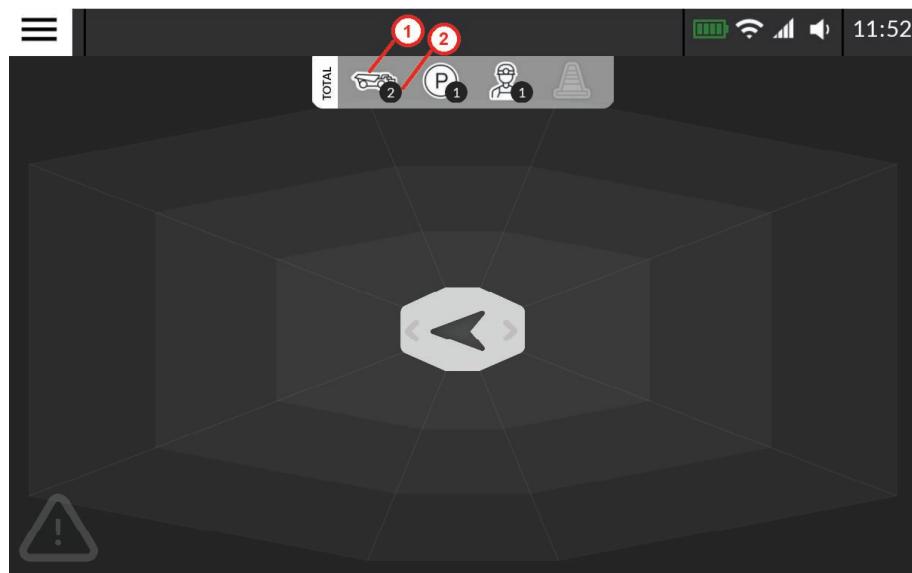
5.3.8   MineProx® Status Bar

⚠ WARNING	
⚠	**RISK OF COLLISION!** **If the NVD loses external power during operation, the vehicle will be shown as parked to other NVDs and will not be positioned on the Bullseye of other CxS-enabled vehicles.** **The NVD must be equipped with a functional MineProx® antenna. The operator must not solely rely on the MineProx® Status Bar. Parked vehicles could still be in the vicinity regardless of the state of the Parked Vehicle RO Count. Make sure that you follow the mine safety working procedures.**

Note!   *If the NVD does not have an internal battery, it needs to remain powered to broadcast a parked state. Parked status can be beaconed by adding a digitally isolated input to the NVD, such as the Ignition signal.*

Note!   *To support the sites where some devices are not yet installed with CxS-enabled equipment and as a fallback when the CxS application is down, the MineProx® status bar was added as an independent detection mechanism.*

1. MineProx® RO types, from left to right:

    a. Vehicles in operation

    b. Parked Vehicle

    c. Pedestrian wearing NPD

    d. Fixed Hazard Beacon

2. MineProx® RO count.

5.3.8.1   Parked Vehicle

⚠️ **WARNING**

	RISK OF COLLISION! **During operation, if the NVD loses external power, the vehicle will be shown as parked to other NVDs and will stop ranging with other CxS-enabled devices.** **The NVD must be equipped with a functional MineProx® antenna. The operator must not solely rely on the vehicle proximity indication. Parked vehicles could still be in the vicinity regardless of the state of alarm. Mine safety working procedures must be followed.**

When a battery powered NVD is no longer powered by an external source, it switches automatically to low power mode. If installed with the internal battery as an option, it uses the battery for a single function, which is to beacon the Parked state over the MineProx® narrow-band frequency.

Note!   *If the NVD does not have an internal battery, it needs to remain powered to broadcast a parked state. Parked status can be beaconed by adding a digitally isolated input to the NVD, such as the Ignition signal.*

For more information, refer to NVD Operation Manual.

5.4   Alarms

⚠️ **WARNING**

	RISK OF COLLISION! **If you ignore or silence a valid alarm indication, it will put people and assets in your area at risk of a collision that could result in death or severe injury.** **Silence an alarm when you are sure and able to do it safely. Mine safety working procedures must be followed.**

⚠️ **WARNING**

	RISK OF COLLISION! **Failure to correct the malfunctions could lead to a collision that could result in death or severe injury. If the service is stopped or failed, the UI will not prompt any Distress notifications.** **It is the responsibility of the operator to inform the maintenance department as soon as a malfunction in the system is observed.**

When you operate the vehicle with the CxS system, some scenarios will trigger an alarm on the UI, and a repetitive audio alarm is played.