# Balfour Beatty



# Contents

## Introduction

Every year in the construction industry, people are killed or injured due to being struck by moving plant. Site personnel, site visitors and the public can all be at risk if the plant and pedestrian interface is not properly managed and controlled.

Data suggests that plant person interface injuries are relatively uncommon. However, due to the power, weight and hardness of plant, compared with the fragility of the human body, when they do occur the consequences are often serious. Increasing investment in roads, standardisation of products and methods, improved collaboration between organisations and developments in technology all offer opportunities to increase the Health and Safety at Work benefits we can derive from the use of plant as well as opportunities to eliminate harm caused by plant.

## Forward

This document is intended to generate collaboration with all stakeholders (OEM's, Supply Partners, Sub-Contractors, Clients, Main Contractors, etc.) to develop a common specification for Human Form Recognition (HFR) camera systems when installed on plant equipment.

A common specification will ensure consistency for operators and the workforce working around plant fitted with these camera systems across the construction industry.

In addition to this, it will also provide the basis for OEM's to develop these systems as a common standard for use throughout the construction industry.

## Scope

A multi camera, modular type camera system which is capable of being installed on mobile plant that detects the human form. Detections should be communicated visually and audibly to the operator of the mobile plant and, where appropriate, audibly to the pedestrian that has been detected. HFR and continuous recording must always be active when the ignition is on.

The camera system must be able to collect data of all detections so that these can be easily displayed on a web-based portal for review (subject to the relevant GDPR compliance) by the end user and interested parties.

Fail safe controls must also be in place and a warning to the operator on the in-cab display as well as an alert on the portal in the event of any component failure or tampering i.e., broken wires, camera failure, obstructed camera view, etc.

Camera systems should be configured so the human form detection zones, as shown in appendix 1, can be achieved with zero blind spot areas and camera systems should be configured so the human form detection zones, as shown in appendix 1, can be achieved with zero blind spot areas.

Minimum scope of machine inclusion –

- Tracked Excavators 13t and above
- Wheeled Excavators 10t and above
- FT Cabbed, wheeled and tracked Dumpers 6t and above
- Articulated & Rigid Dump Truck 9t and above
- Cabbed Roller 13t and above
- Telehandler (All sizes including Roto Telehandlers)
- Dozers (All sizes)
- Wheeled Loaders
- Graders

Items for consideration in the near future –

- Piling Rigs
- Crawler Cranes

## Standards

Several standards come into action for this type of technology. Although there is no one individual standard the encompasses everything that is required but all systems must be CE or UKCA certified.

## Minimum Camera Specification

- 720p HD
- Colour
- 25 Frames per second
- Detection achievable in low level light (Min 0.1 Lux)
- IP68 protection
- 8-24v DC power range
- Operating temperature between -20 ~+60°C
- Relative humidity up to 90%
- Vertical and horizontal adjustable mountings
- Camera fault alarm

Accuracy levels for detection of the whole system must be above 95%. This will need to be verified via data captured during testing of the system as laid out in Appendix 2 – MIRA HFR Accuracy Test criteria.

## Red Zones & Hierarchy of Controls
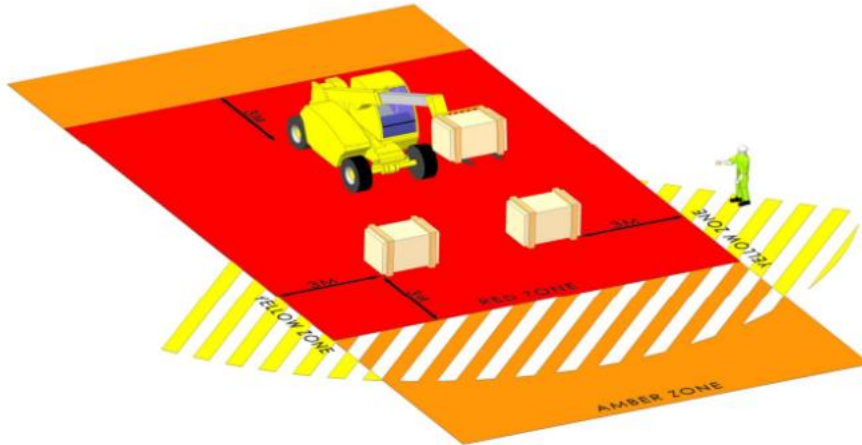


Red zones are commonly used in the construction industry to inform personnel of the dangers of working withing the vicinity of plant and vehicles on site. Red zones are also linked to company hierarchy of controls and form a basis for training material.

Individual company policies and procedures must be considered when using this technology to ensure compliance.

This Human Form Recognition technology has been developed to provide assurance that red zone training is being complied with. The system's primary function is to advise the plant operator that a person has, or is about to, enter the operating zone of the plant.

It remains the responsibility of the pedestrian to never enter the operating zone unless the plant operator has made it safe to do so and confirmed this to the pedestrian.

## Functionality

**Audible Alarms –** when pedestrian detected: -

**Internal**

**HFR Outer Zone** – Subtle audible alert (such as beeps) when a pedestrian enters the detection zone. This is to attract the attention of the operator to the pedestrian detection.

**HFR Inner Zone** – Spoken alarm e.g. "**Person Detected**" repeated twice when a pedestrian enters the detection zone.

**External**

HFR Outer and Inner Zones – Repeating spoken alarm – for example, "**Danger - Move away**", "**Caution. Machine in operation"**

**Alarm must cease as soon as the pedestrians are no longer detected.**

External alarms to have a supervisor level deactivation system when working in noise sensitive areas so these can be turned off - i.e., during night works or close proximity to housing.

**Visual Alarms – when pedestrian detected: -**

Internal: -

- Visual zonal alert that stays illuminated (Amber HFR Outer Zone or Red – HFR Inner Zone) and displays where the pedestrian is while person remains present within the zones. Display must be positioned in such a way that it will be at the operator's eye level.
- In machines where the operator station rotates, displays must be shown in both orientations.

**Optional equipment**

- CCTV Display screen – optional.

**Managing False Alerts**

The operator must continue to be notified visually of any pedestrians in the outer and inner zones even if the machine is in a "safe" state.

Internal audible notifications must be silenced whilst machine is in a "safe" state.

Video clips and incursion data must only be active when machine is in work mode i.e., Deadman lever engaged, or handbrake is released (for machine without Deadman levers).

**Digital Thumbs-Up Safe Approach Indicator**

A digital thumbs up indicator mounted on the exterior of the machine facing the entry zones, (see Appendix 1– Default Detection Zones) that facilitates both visual and verbal notifications controlled by a "thumbs-up" button within the cab (easy to access) at the operator station to indicate authorization has been granted by the operator for pedestrians to approach the machine.



Allows for definitive mutual understanding between operator and pedestrians when wanting to approach a machine.

**Engagement and Disengagement:**

The operator will press the button when the deadman lever is disengaged, signalling the machine is safe to approach (no recording should occur during this mode). This button will activate a clear green indicator light iplaced on the outside of the machine facing the entry zone, informing personnel on-foot that it is safe to approach or enter the dedicated entry zone. When the machine is required to resume operation again the

operator will press the thumbs up button again before engaging the deadman. This action will now deactivate the safe mode changing the indicator to red, signalling it is no longer safe to approach. It should not be possible to engage the green safe approach while the deadman lever is still engaged. Similarly, if the green safe approach is not disengaged before the deadman lever is re-engaged, the green safe approach should automatically revert to the red indication.

**System Integration:**



The Thumbs Up button functionality will be integrated with the Human Form Recognition (HFR) systems, ensuring that visual and audible alarms are managed in accordance with the Managing False Alerts requirements. This integration ensures consistency in safety signals across various systems and components of the machinery.
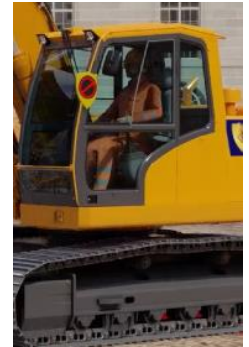
## Zone changes

Occasionally, changes to the default detection zones will be identified following specific risk assessments of the activities. Changes to the zones need to be actionable in a timely and easy to do manner, either over the air or via a connected device.

## Data & Recording

Any personal data that is captured by this camera system must be in line with current GDPR regulations and each company employing this technology must carry out their own Data Protection Impact Assessment (DPIA).

Whilst the majority of data captured is numerical and location data, the video capture data is classed as personal data as identification can be made to an individual.

In certain circumstances, data and video capture may not be authorised or allowed by the client, for example military installations and certain parts of the power generation industry. It is advisable to check with the client before any such technology is deployed on these sites.

**Data Points –** (non-video)

Below is a list of minimum data points required from the HFR camera system: -

- **Company name** – refers to the company name where the data is being collected.
- **Incident ID** – Unique detection id number
- **License / Registration Plate** – Plant asset ID Number
- **Alert Tag (Outer/Inner Detection Zone)** – Classification of detection
- **Latitude** – for location of the detection
- **Longitude** – for location of the detection
- **Date** (of alert) – in dd/mm/yyyy format
- **Time** (of alert) – in 24hr format
- **Supplier of Asset** (Plant) – Company name of the owner of the HFR System
- **HFR Outer Zone**
    - All Outer Zone detection videos will be stored locally on the internal hard disc storage device on the item of plant and numerical data of detections will be visible in the Management reporting system.

- **HFR Inner Zone**
  - • All Inner Zone detection videos (10 sec clip) will be "thumb nailed" on the internal hard disc storage device. These clips can be downloaded upon request and stored on Cloud based portal for ease of review by interested parties. All numerical data of detections will be visible in the Management reporting system.

Min 250hrs on board data storage for incursions and continuous video footage. All video footage must be compliant with GDPR legislation and be capable of "over the air" download.

Event, numerical and video data must be API (Application Programming Interface) capable.

## Dashboard & Reports

All systems must be installed ready to connect and transmit data to a cloud-based data portal so that the data collected by the HFR camera system can be easily accessed and reviewed.

Each end user will have their bespoke requirements and the format of this data will be specific to individual companies.
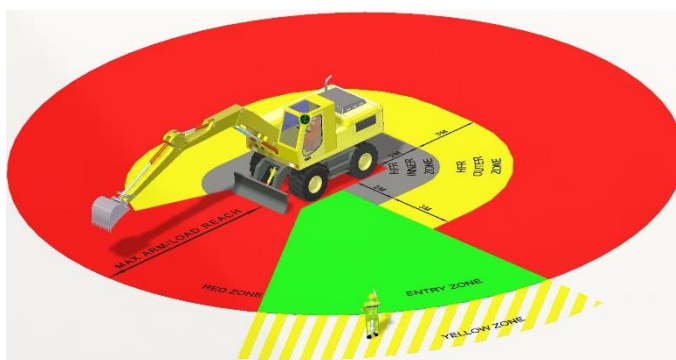
## Appendix 1 - Default Detection Zones

## Excavators 13t and above
**250° Detection Coverage + 360º recording.**
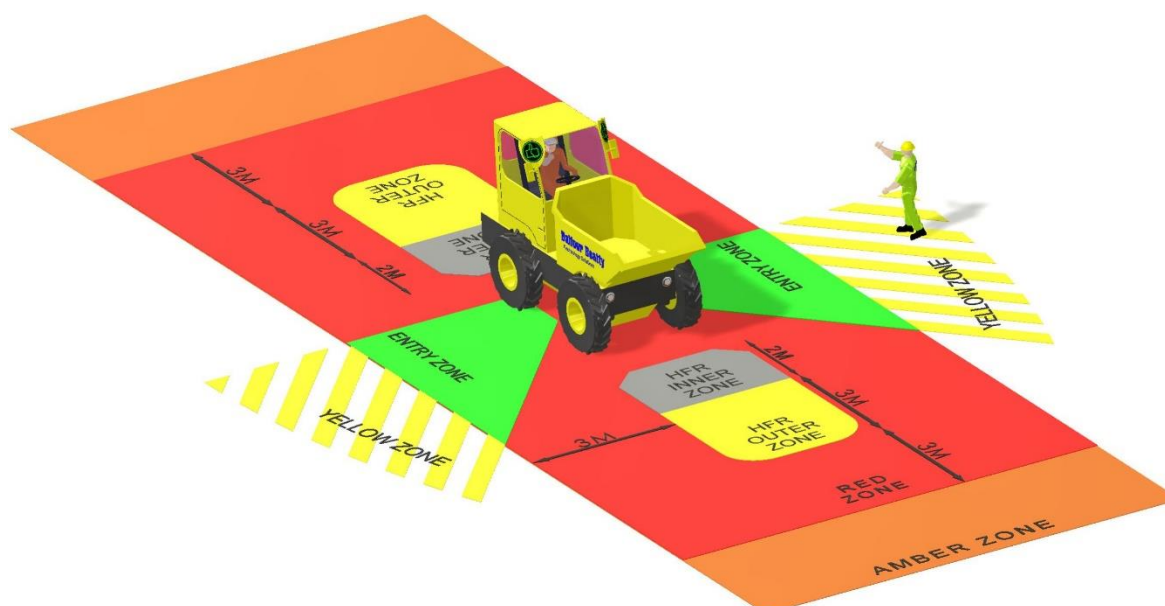
### 5m Detection Zone

- 2m – 5m Zone (HFR Outer Zone)

- 0m – 2m Zone (HFR Inner Zone)



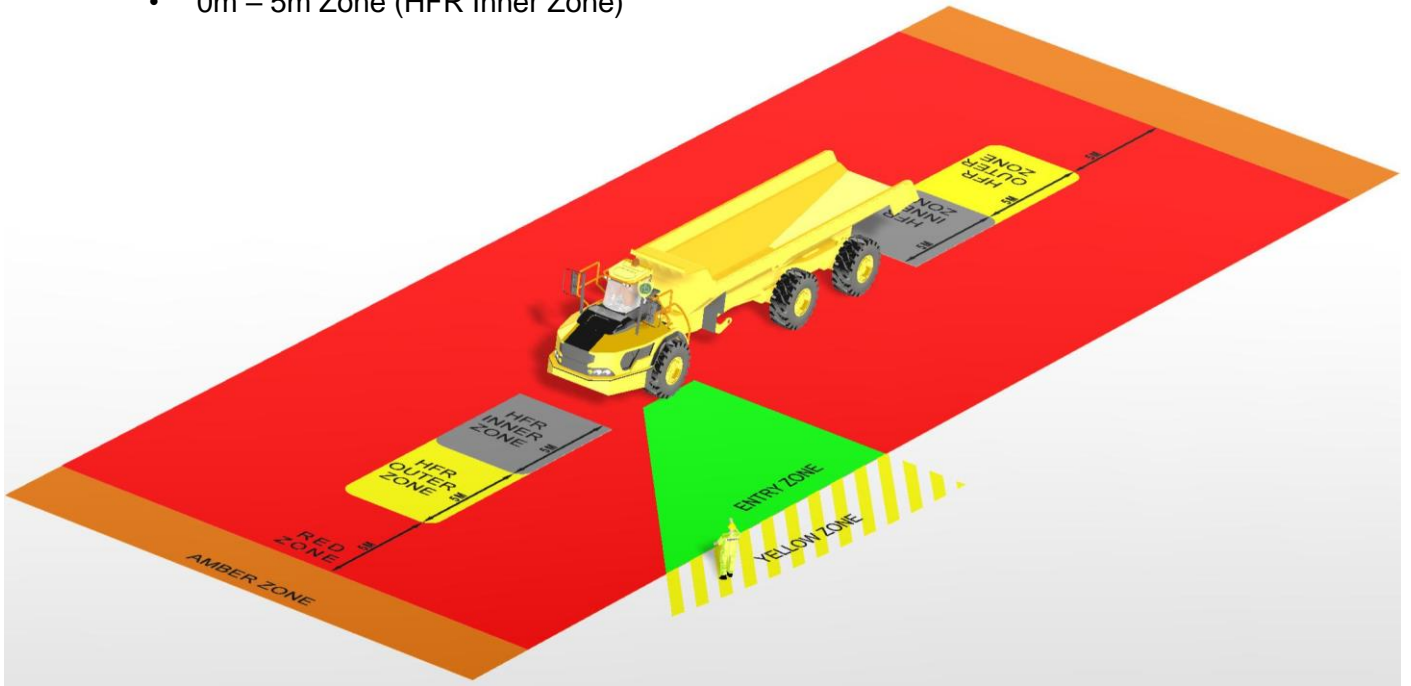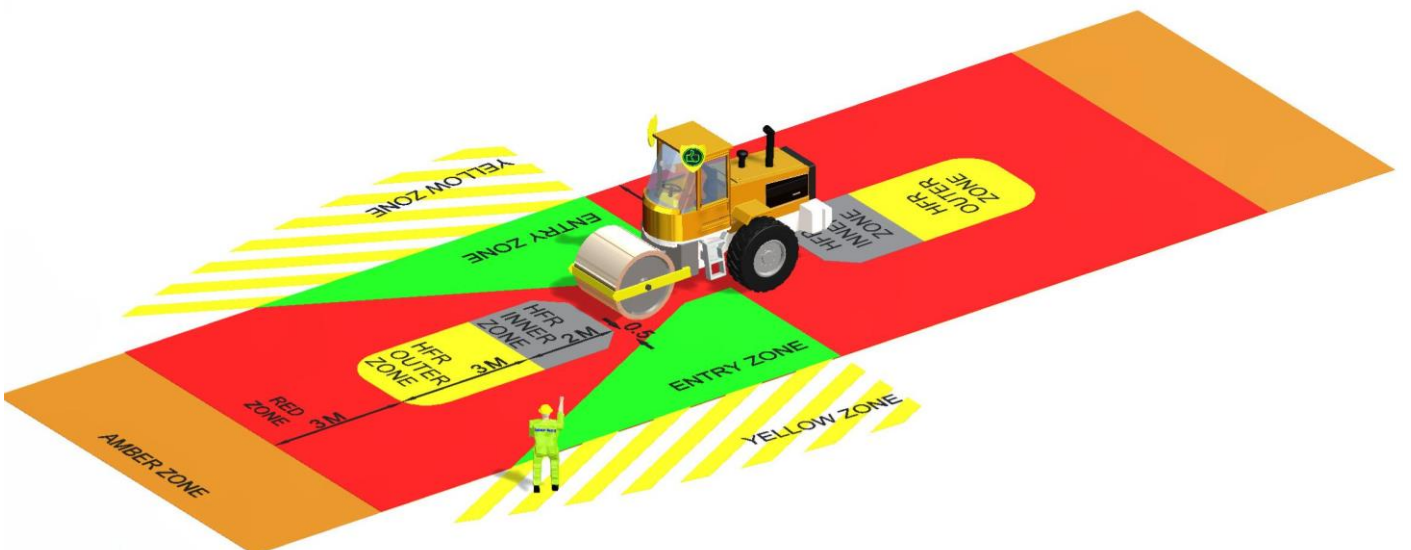## FT Dumper 6t and above
### 5m Front & Rear Detection Zone + recording

- 2m – 5m Zone (HFR Outer Zone)

- 0m – 2m Zone (HFR Inner Zone)

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## Articulated Dump Truck 9t and above

### 10m Front & Rear Detection Zone + recording

- 5m – 10m Zone (HFR Outer Zone)

- 0m – 5m Zone (HFR Inner Zone)



## Roller 13t and above

### 5m Front & Rear Detection Zone + recording

- 2m – 5m Zone (HFR Outer Zone)

- 0m – 2m Zone (HFR Inner Zone)

## Telehandler all sizes

### 250-degree Detection Coverage + 360º recording

#### 5m Front & Rear Detection Zone

- 2m – 5m Zone (HFR Outer Zone)

- 0m – 2m Zone (HFR Inner Zone)

#### Body Sides Detection Zone

- 0m – 1.5m Zone (HFR Inner Zone)
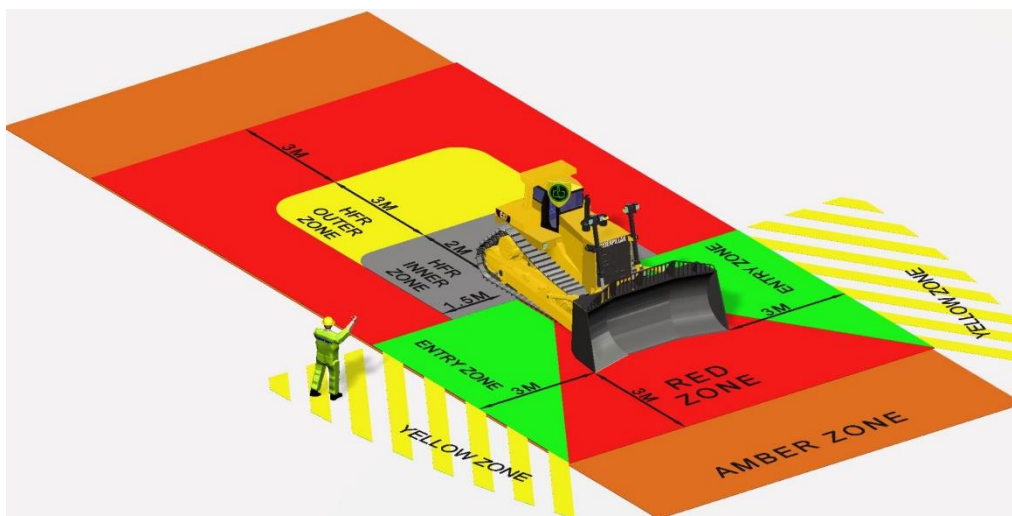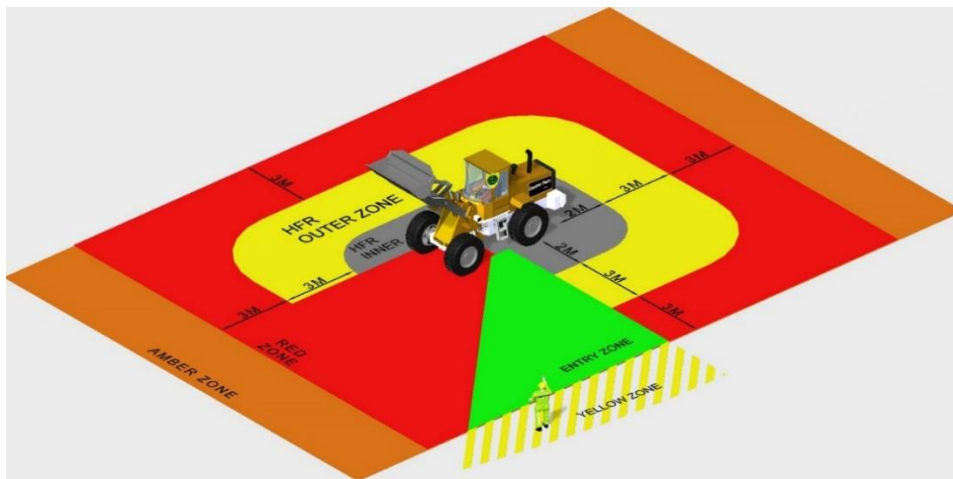


## Dozers

### 180-degree Detection Coverage + recording

#### Rear Detection Zone

- 2m – 5m Zone (HFR Outer Zone)

- 0m – 2m Zone (HFR Inner Zone)

#### Body Sides Detection Zone

- 0m – 1.5m Zone (HFR Inner Zone)

## Wheeled Loaders

**270-degree Detection Coverage + 360º recording**
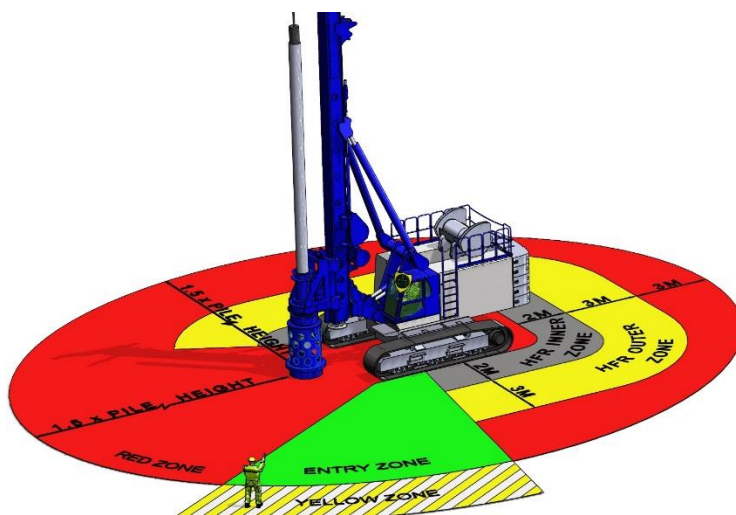
### 5m Detection Zone

- 2m – 5m Zone (HFR Outer Zone)

- 0m – 2m Zone (HFR Inner Zone)



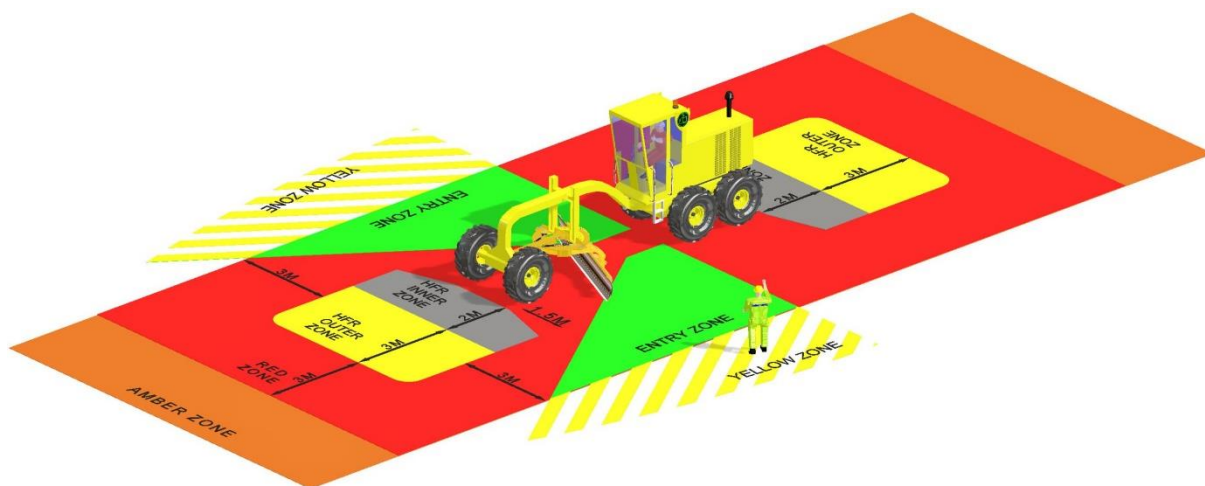## Piling Rigs

**250-degree Detection Coverage + 360° recording**

- **5m Detection Zone**

  - 2m – 5m Zone (HFR Outer Zone)

  - 0m – 2m Zone (HFR Inner Zone)

## Graders

**5m Front & Rear Detection Zone + recording**

- 2m – 5m Zone (HFR Outer Zone)
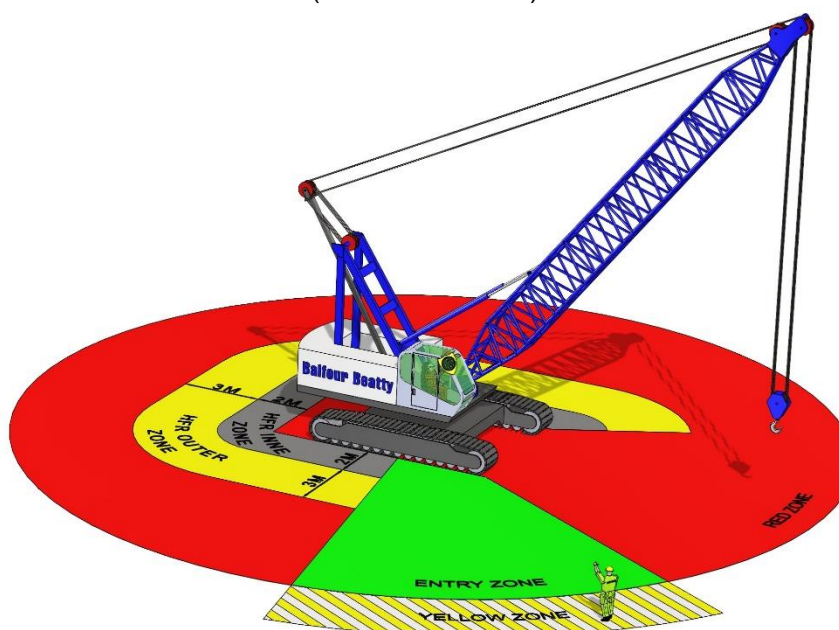
- 0m – 2m Zone (HFR Inner Zone)

## Crawler Cranes

**250-degree Detection Coverage + 360° recording**

  **5m Detection Zone**

- 2m – 5m Zone (HFR Outer Zone)

- 0m – 2m Zone (HFR Inner Zone)

## Appendix 2 – HFR Accuracy Test Criteria



Accuracy testing is an important function when using human form recognition cameras on construction plant as poor performance could result in incidents and potentially fatalities occurring.

The requirement for accuracy testing demonstrates the reliability of detecting pedestrians within the detections zones as shown in appendix 1 – Default Detection Zones.

The Horiba MIRA Test Criteria will need to be carried out and verified by Balfour Beatty's Product Manager for any Human Form Recognition system solutions so that approval can be obtained from Balfour Beatty.

A copy of this Test Criteria can be requested by e-mailing HFRSupport@balfourbeatty.com