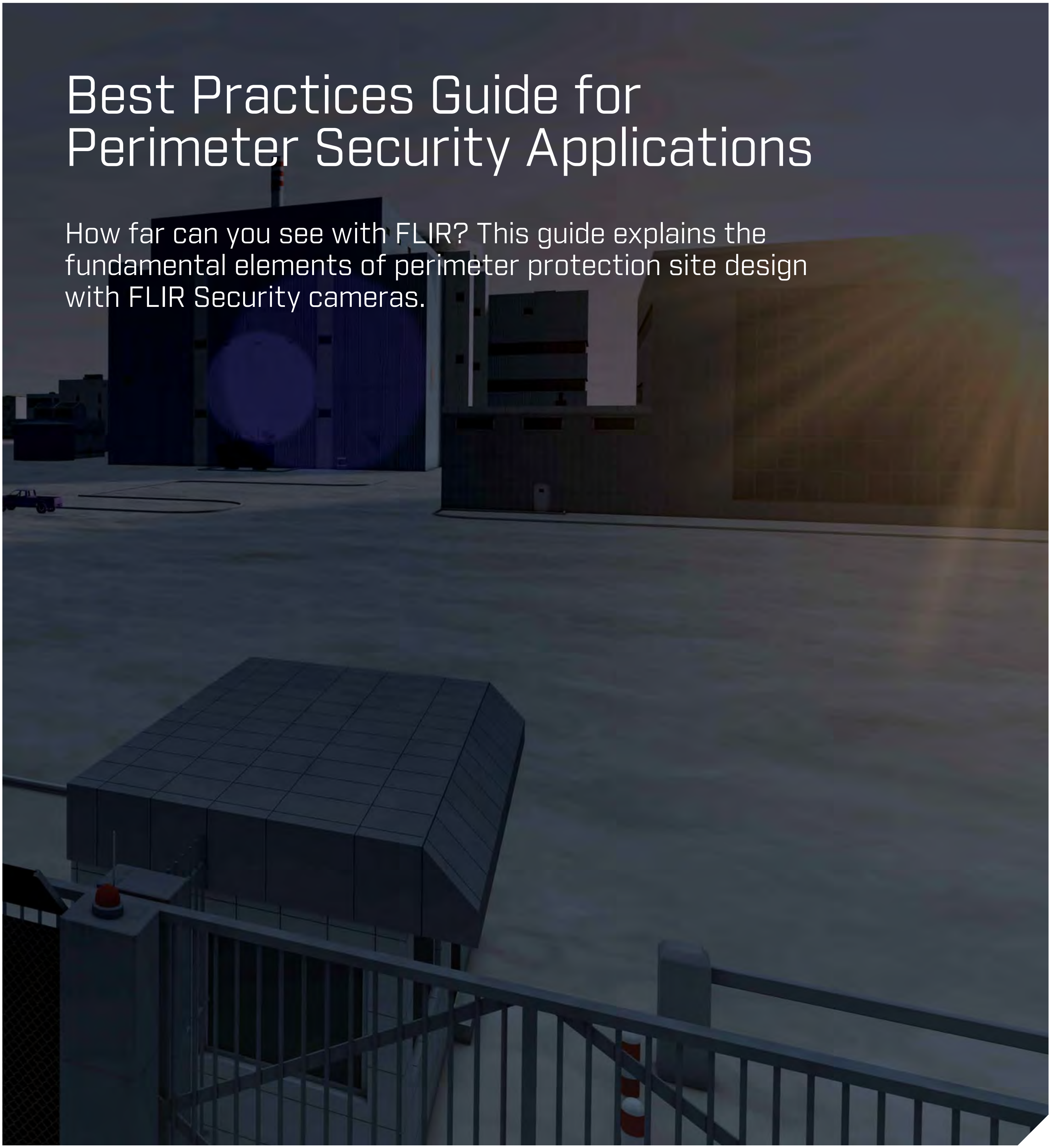
Technical Note

Best Practices Guide for Perimeter Security Applications

How far can you see with FLIR? This guide explains the fundamental elements of perimeter protection site design with FLIR Security cameras.



FLIR® | The World's Sixth Sense®

Where to start

The fundamental concept of designing a perimeter protection application involves creating a virtual line that separates external from internal areas. In most cases, an intrusion is considered the moment a target crosses the virtual line by moving from an external to an internal area. In some cases, however, it is also necessary to detect targets that are either encroaching on the virtual line or moving within a predefined internal area.

In order to determine design parameters—such as camera placement and height, lenses, and distances—several calculations are required to ensure that the following terms are met:

1. There must be sufficient coverage across the virtual line to eliminate all "dead-zones" where a potential target is not fully covered by a surveillance camera's field of view
2. Target size validation must meet the performance criteria required by a given camera's video analytics, from the nearest to the most distant points covered by each of the cameras along the fence line

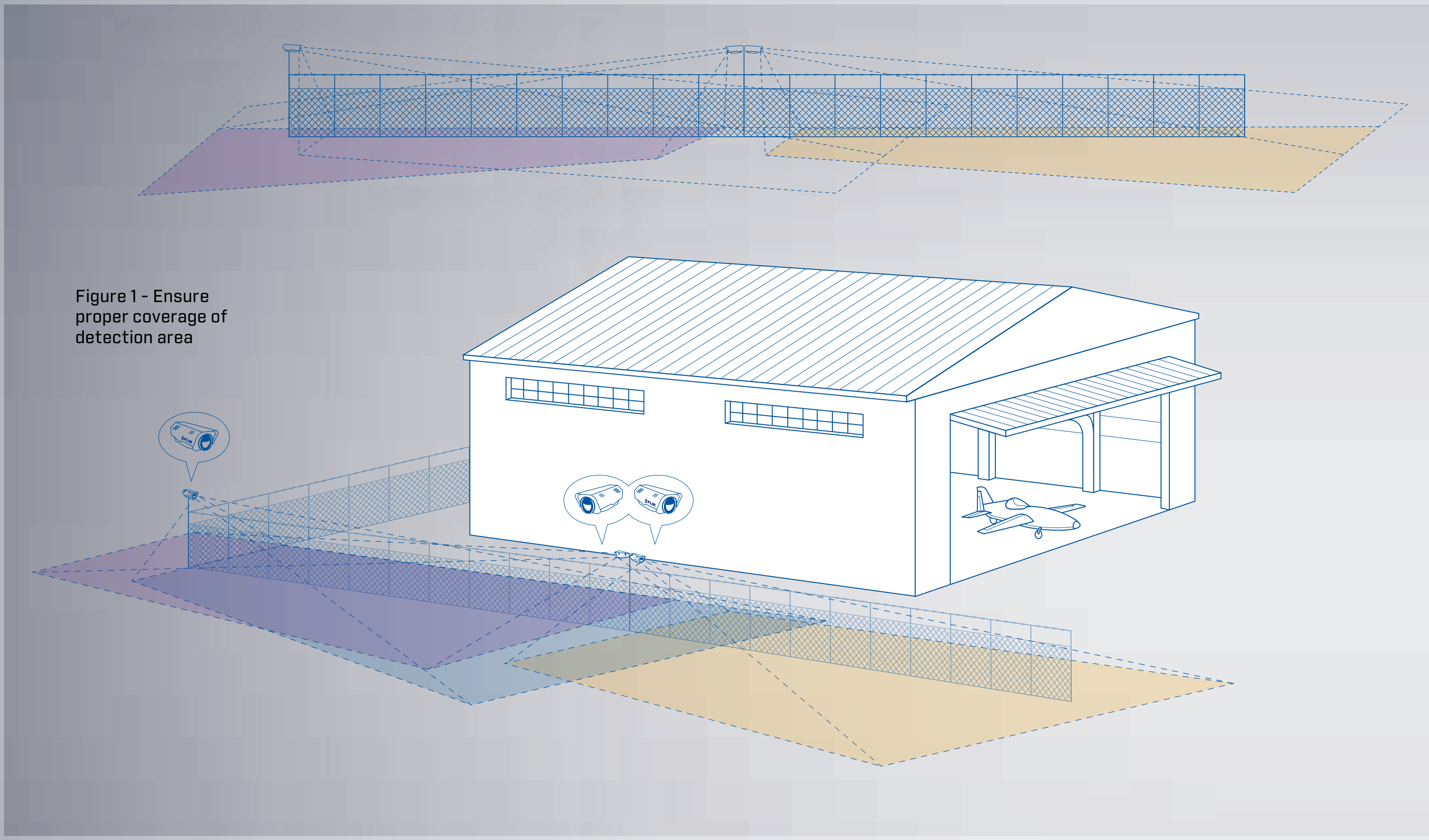


Figure 1 - Ensure proper coverage of detection area

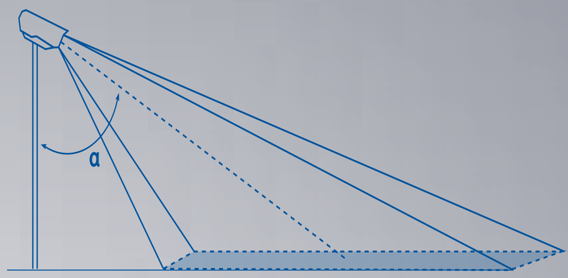
Various tradeoffs apply between target size and coverage. Generally, widening the camera's coverage results in smaller targets across the field of view. Therefore, the best way to start is with the application requirements:

- Does the application require detection or recognition? Must it distinguish between humans and vehicles?
- What are the key alarm scenarios? Should an alert trigger when a target crosses the virtual line or when it simply approaches it?
- Do I favor performance over costs? The probability of detection increases when more cameras are used and allow for overlapping coverage. On the other hand, it is possible to use fewer cameras and still guarantee high performance, most of the time

Camera placement

When determining camera placement, there are several ways to achieve optimal area coverage and fence line protection. Best practices consider the specific perimeter layout, application requirements, and site topology. However, in most cases, optimal performance and efficiency are achieved by placing cameras so that their fields of view runs parallel to the fence line and perpendicular to the movement of potential intruders approaching or crossing the perimeter.

Within the camera's field of view, the highest probability of detection and the lowest rate of false alarms are achieved when targets move horizontally from one side of the camera image to the other. The following are considered best practices for camera positioning to ensure full camera coverage across the perimeter.



- Install the camera at a height of 4 meters (13 ft) or more
- Direct the camera towards the ground with a tilt angle within a range of 45-60 degrees (tilt angle is defined as the angle measured between the camera pole and the center of the camera's field of view)

Figure 3 **INCORRECT CAMERA PLACEMENT**

Security hole allows intruder to approach without head-to-toe visual needed for proper size classification and detection

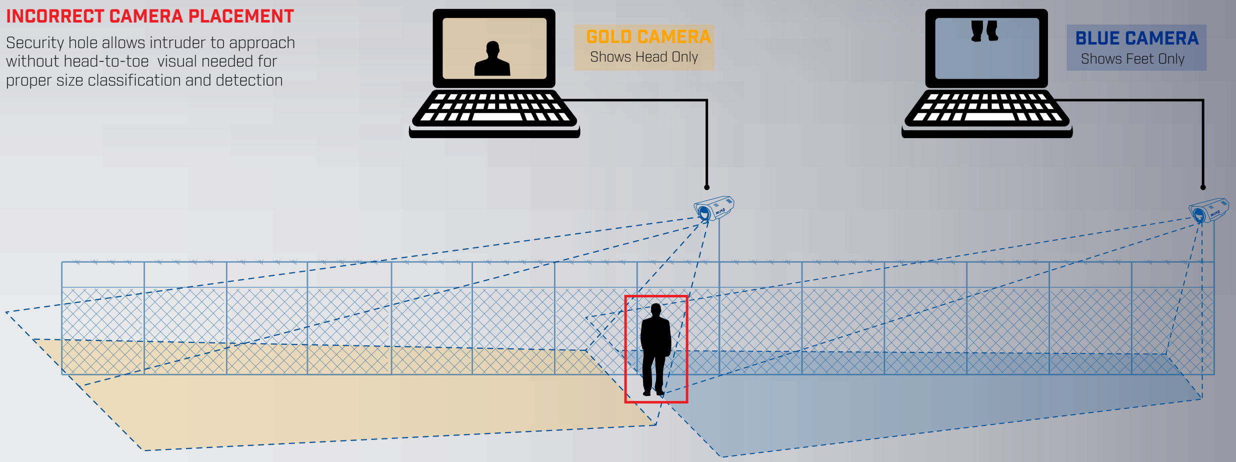
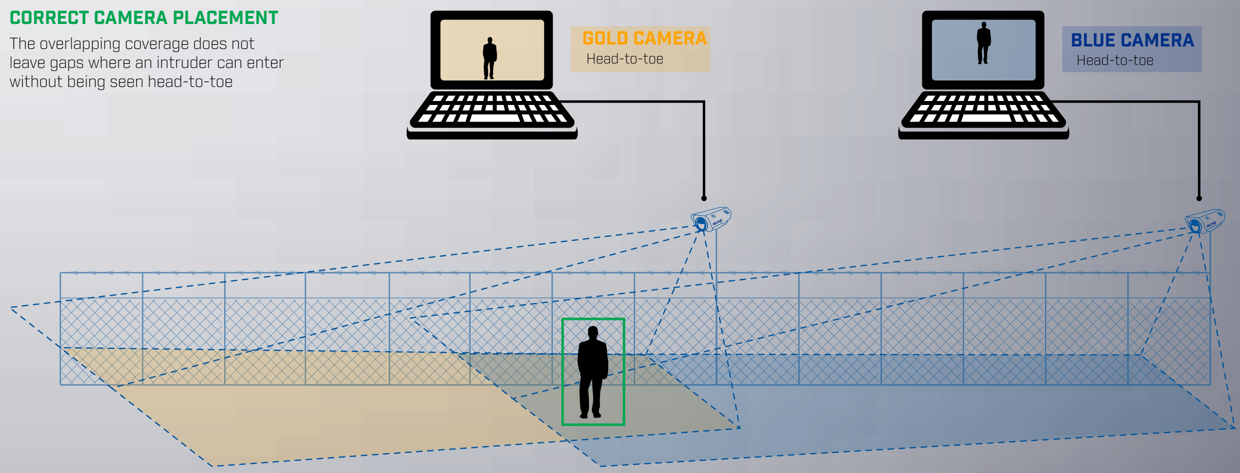


Figure 4 **CORRECT CAMERA PLACEMENT**

The overlapping coverage does not leave gaps where an intruder can enter without being seen head-to-toe



- For installations with multiple cameras, the fields of view of cameras should overlap in order to remove all dead zones in which a camera cannot see a target "head to toe"
- For optimal performance, position cameras so their field of view runs parallel to the fence line and perpendicular to intruder movement, rather than directing them so they will face approaching targets
- Position the cameras so their field of view sees as little of the skyline as possible. When determining the camera positioning, consider whether you only need to detect the moment of intrusion or when a target simply approaches an area
- Make sure that cameras are mounted on stable poles with minimal vibrations and maximal resistance to wind.

Choosing the right lens

The main consideration when choosing a lens is its focal length, which has a significant impact on both the camera's field of view and target size. Greater focal length increases the magnification of objects in the field of view, such that they are represented by a larger number of pixels. In other words, greater focal length means larger targets for video analytics, resulting with greater detection distance. See figure 5.

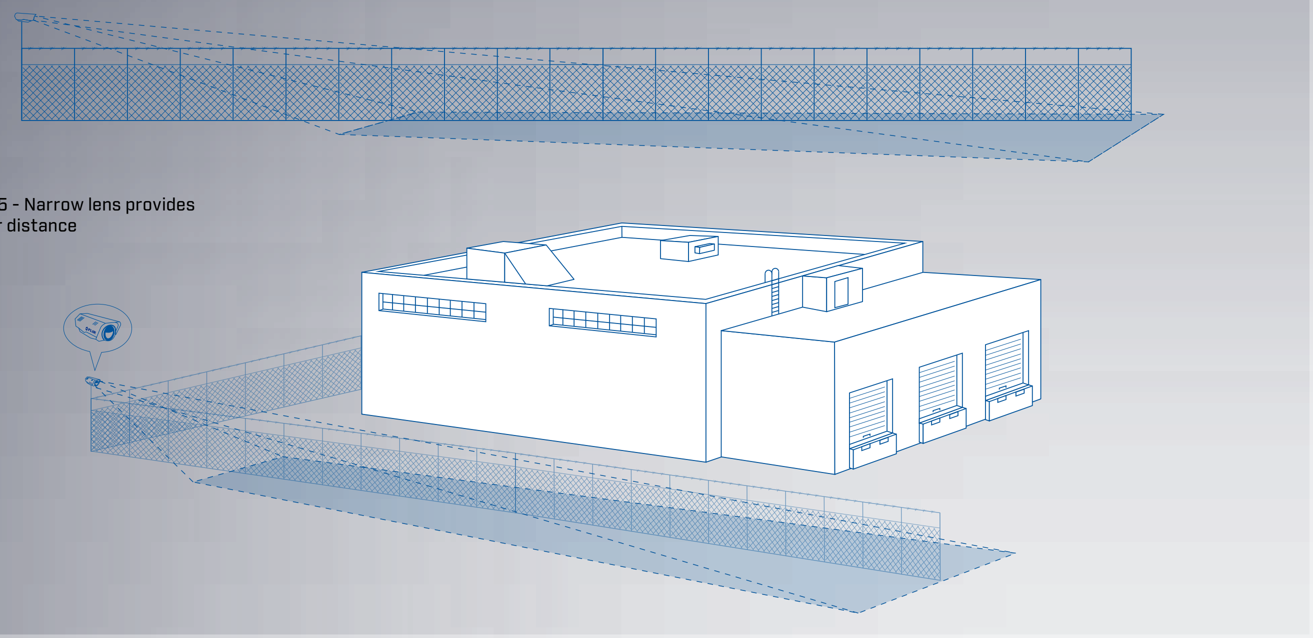


Figure 5 - Narrow lens provides greater distance

On the other hand, the correlation of focal length and field of view is exactly the opposite: the smaller the focal length, the wider the field of view. See figure 6. This means that when choosing the proper lens, one needs to consider the trade-off between detection distances and the width of the scene. In most cases, the best practice is to define the minimal requirement for scene width and choose the largest available focal length to meet the width criteria.

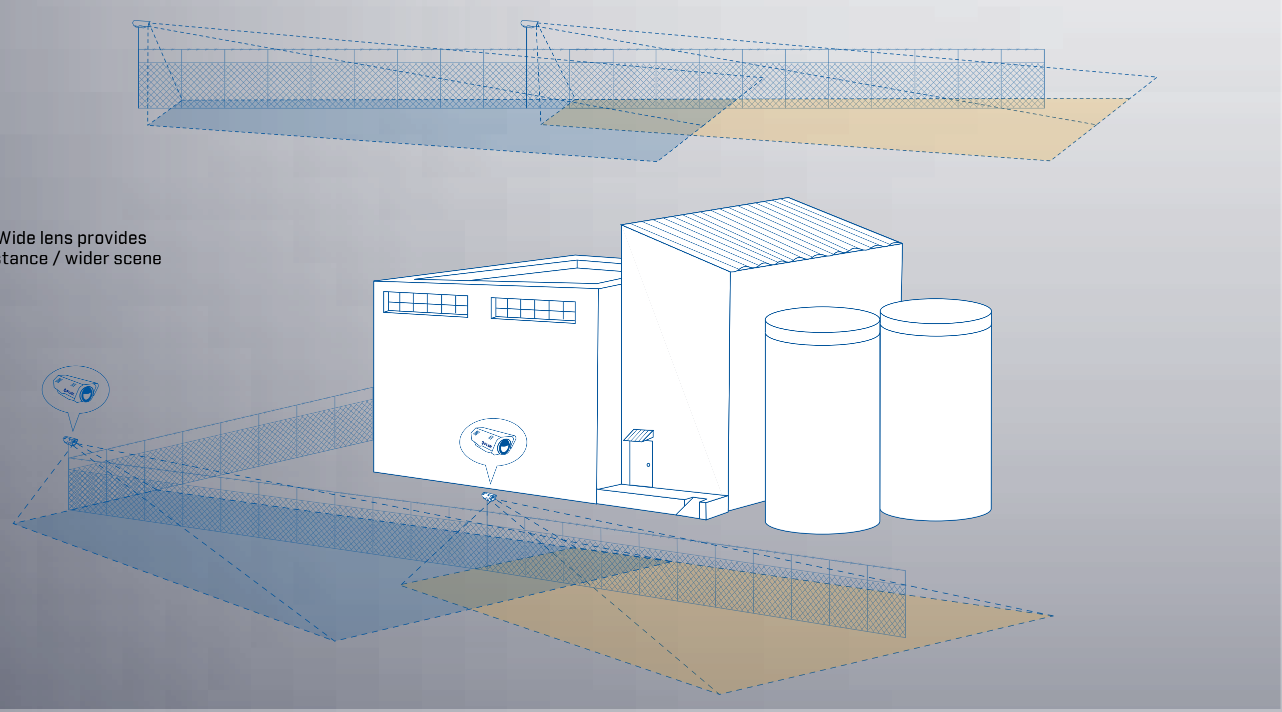


Figure 6 - Wide lens provides shorter distance / wider scene

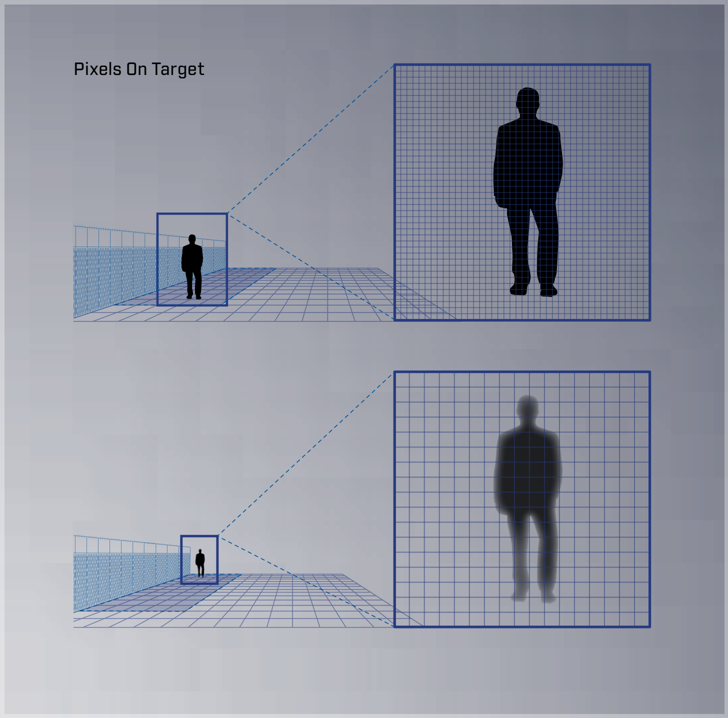
Target size and detection range

Target size is a term used to calculate the maximal distance a FLIR camera with built-in analytics can detect a target. This distance is also referred as "detection range."

Target size is determined by the number of pixels representing the target within the camera image, and is also known as "Pixels On Target" (POT). Other than the target size, which is the critical factor, detection range criteria also depends on a large number of environmental and system variables, including the background temperature (hot desert versus cold snow) and atmospheric conditions (clear skies versus fog). Both directly influence the scene's contrast level; the visibility of the target; and the ability to understand the nature of the target (moving vehicle vs. crawling human), its speed, and movement.

For this reason, determining detection ranges should be treated as a statistical evaluation that takes these additional factors into account. As a best practice, the following formula is provided to calculate the detection range under optimal conditions where implicating factors do not negatively impact the performance of the built-in video analytics' detection range. In other words, detection under optimal conditions reflects the maximal achievable distance in practical scenarios.

In addition to detection, the formula can be used to calculate classification ranges under optimal conditions. The difference between detection and classification is that while detection results with alarms that are triggered by either human or vehicle targets, classification allows one to distinguish between the two, and configure the system such that it will generate an alarm for specific types of targets, while ignoring others.



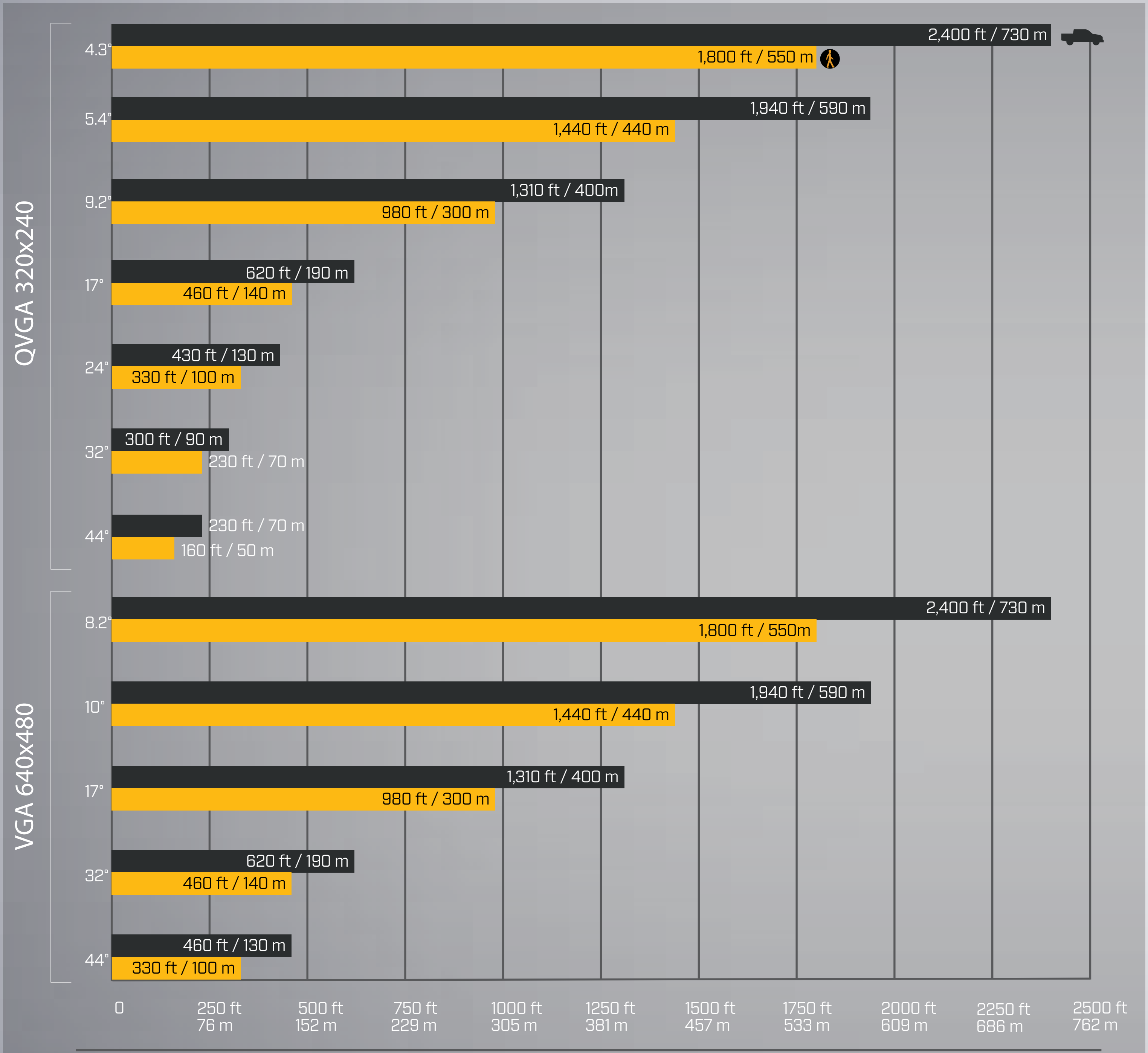
FLIR offers an online, easy-to-use product planning tool called Raven that is a convenient way to calculate the target size / POT for any given FLIR thermal camera model at any given distance. Determine the detection or classification range based on the maximal distance where the detection or classification criteria are met.

Target size (meter)	Required Pixels on Target for Detection (Optimal conditions)	Required Pixels on Target for Classification (Optimal conditions)
Human (0.5 x 1.8)	3 x 9.5	4 x 13.5
Vehicle (5.0 x 1.5)	23 x 6.5	30 x 8.5

Using current satellite imagery, the Raven Site Planning Tool allows users to simulate the placement of FLIR cameras in highly accurate, coordinate-controlled locations.

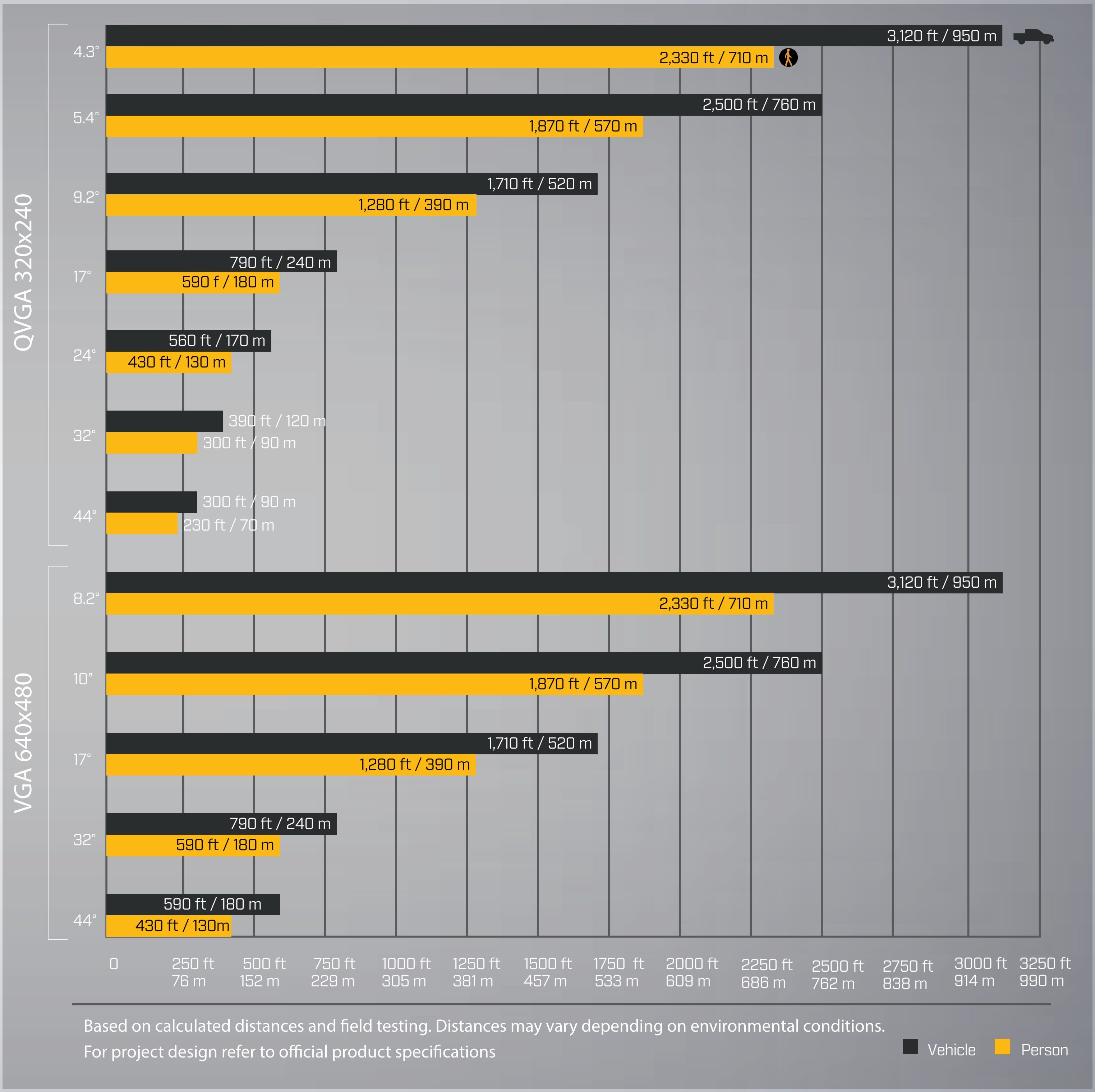
The following table can be used as a quick reference for FC-Series ID camera line detection and classification distances.

Classification Range

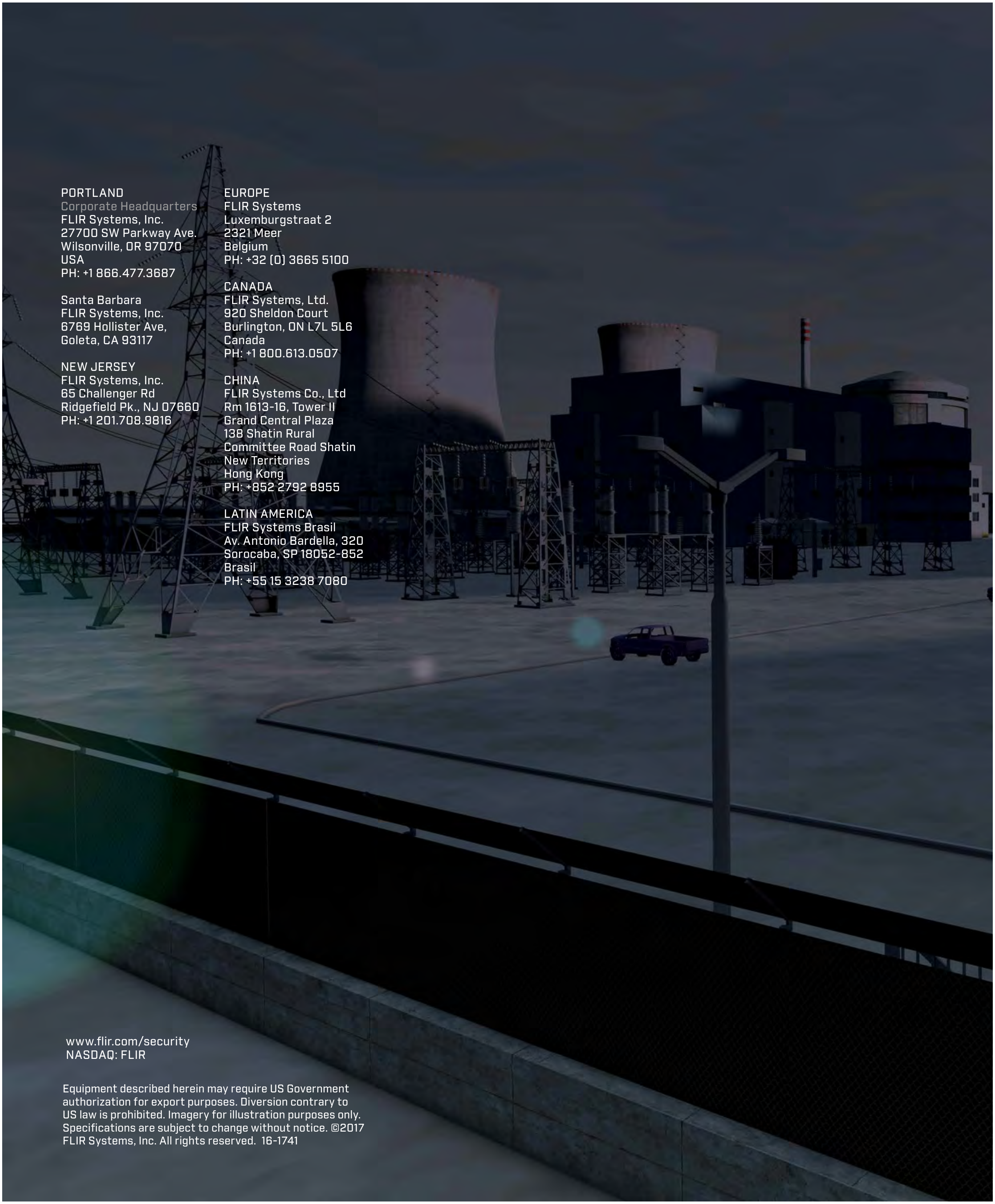


Based on calculated distances and field testing. Distances may vary depending on environmental conditions.
For project design refer to official product specifications

Detection Range



Based on calculated distances and field testing. Distances may vary depending on environmental conditions.
For project design refer to official product specifications



PORTLAND
Corporate Headquarters
FLIR Systems, Inc.
27700 SW Parkway Ave.
Wilsonville, OR 97070
USA
PH: +1 866.477.3687

Santa Barbara
FLIR Systems, Inc.
6769 Hollister Ave,
Goleta, CA 93117

NEW JERSEY
FLIR Systems, Inc.
65 Challenger Rd
Ridgefield Pk., NJ 07660
PH: +1 201.708.9816

EUROPE
FLIR Systems
Luxemburgstraat 2
2321 Meer
Belgium
PH: +32 (0) 3665 5100

CANADA
FLIR Systems, Ltd.
920 Sheldon Court
Burlington, ON L7L 5L6
Canada
PH: +1 800.613.0507

CHINA
FLIR Systems Co., Ltd
Rm 1613-16, Tower II
Grand Central Plaza
138 Shatin Rural
Committee Road Shatin
New Territories
Hong Kong
PH: +852 2792 8955

LATIN AMERICA
FLIR Systems Brasil
Av. Antonio Bardella, 320
Sorocaba, SP 18052-852
Brasil
PH: +55 15 3238 7080

www.flir.com/security
NASDAQ: FLIR

FLIR | The World's Sixth Sense®