Study on Assessment Zone Setup Methodology for CCTV Systems at the Nuclear Power Plants

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1. Introduction

Intrusion Detection Sensors(IDS) with surveillance cameras have been installed between the double fences at the nuclear facilities to detect an adversary. The cameras have 2 major functions. One is to provide supplemental information about a malicious act, such as who, what, where, and how many. Another is to assess the cause of each sensor alarm event, because intrusion detection sensors could provide false alarms which are produced by itself and nuisance alarms which can be produced by the environment effects. Assessment is a critical component of detection and is equally important to the initiation of response. The purpose of this study is to introduce assessment zone setup methodology for Closed-Circuit TeleVision(CCTV) systems and carry out the feasibility study on it

2. CCTV System Components

CCTV system consists of various components like Camera, Lens, Lighting system, Transmission system. First of all, it is necessary to explain some important components among all CCTV system components in order to identify assessment zone.

2.1 Camera Imager Format

The basic function of the camera imager is to convert an optical image of the physical scene into an electrical signal. There are two kinds of imagers. One is Charge Coupled Devices(CCD) and another is Complementary Metal Oxide Semiconductor(CMOS). Most of CCTV Cameras are using CCD imager

The image device format is related to the size of the photosensitive surface and is a measure of the diagonal of the scanned rectangular. The most common formats for solid-state cameras are 8-mm and 6-mm. Some of the higher resolution(ex. mega pixel) come in the 11-mm-diagonal format

Table I. Camera Imager Format and Sizes

Format	Diagonal	Height x Width
1 inch	16 mm	9.6mm x 12.8mm
1/2 inch	8 mm	4.8mm x 6.4mm
1/3 inch	6 mm	3.6mm x 4.8mm
1/4 inch	4 mm	2.4mm x 3.2mm

2.2 Lens Format

Basic function of the lens is to control the focal length and F-number. Focal length is the single most important factor in proper lens selection. It determines the relative magnification of the object. The lens format size defines the maximum usable image created by the lens. Standard lens formats are matched to the format of the camera selected.

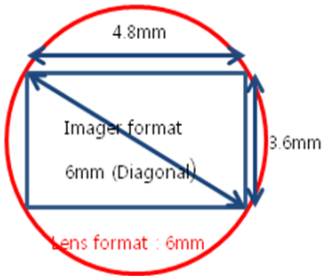

Fig.1 Lens Format

3. Assessment Zone Setup

The most important factor to assess the alarms produced by IDS is the way to identify assessment zone. It is possible to determine the reason why the alarm alerts if the assessment zone identified in a right way

3.1 Levels of Resolution

Selection of a camera and lens combination for a CCTV system starts with the determination of the degree of resolution to be required. There are 3 levels of resolution to be recommended by IAEA. The first one is Detection Level which can determine presence of object. However, exact identification of the object may not be possible. The second one is Classification Level which can determine nuisance or real alarms. The third one is Identification Level which can identify of object. Three levels of resolution dependent on the camera's resolution, size and proximity of the object the camera.

Table II. Level of Assessment Resolution

Detection	Classification	Identification
2-3 Pixels /30Cm	8-12 Pixels /30Cm	13-21 Pixels /30Cm

3.2 Assessment Zone Setup Methodology

3.2.1 General

Basically, assessment zone should be coincident with detection Zone. If assessment zone for CCTV system doesn't completely encompass detection zone for IDS, it is impossible to assess the alarms produced by sensors which is not included in assessment zone. In this case, assessment zone changes should be done, or additional camera deployment should be considered.

3.2.2 Assessment Zone Setup Procedure

The first step is to calculate the maximum usable zone length for assessment zone setup based on zone width and resolution requirement according to assessment resolution at the end of the zone

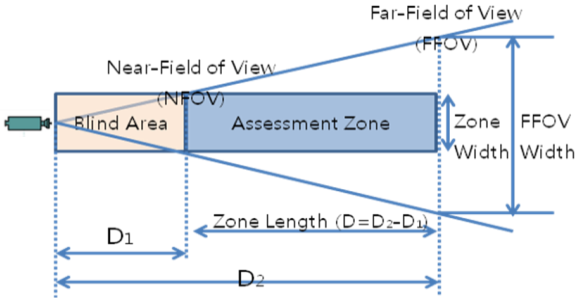

Fig.2 Perimeter Assessment Zone Geometry

If a camera has been tested and found to provide its resolution, it is possible to calculate the Far-Field Of View(FFOV) width and distance from bottom of the camera to FFOV to be able to classify a 30 Cm. For example, if a camera provides 800 pixels of horizontal resolution. Maximum FFOV width is calculated to 30m using below equation. Because 8 pixels are required to classify a 30 Cm human shape according to assessment resolution.

$$(\frac{30Cm}{8Pixels}) \times 800Pixels = 3{,}000Cm = 30m$$

Next step is to calculate the length of Near-Field Of View(NFOV) and FFOV using zone length equation. The zone length equation suggested by IAEA is as below.

$$Dn = \frac{FOV \times FL}{WI} \quad [1]$$

FOV : Width of camera view at a distance
FL : Focal Length of Lens
WI : Width of Imager

Zone length(D) can be calculated by subtraction between distance from camera to FFOV(D_2) and NFOV(D_1). Also note that distance between camera and NFOV is a blind area that cannot be seen by the camera.

$$D = D_2 - D_1 = \frac{FFOV \times FL}{WI} - \frac{NFOV - FL}{WI}$$

Finally, assessment zone can be setup by making zone length and width which are produced through level of assessment resolution and zone length equation.

4. Conclusions

This paper suggests assessment zone setup concept and methodology recommended by IAEA. It is determined that CCTV system's assessment zone setup is a very important factor to monitor and deter threats, because it gives us information how many CCTV cameras are needed and where CCTV cameras are installed. Thus, it is necessary that this assessment zone setup methodology should be developed and applied for designing and evaluating alarm assessment systems. KINAC is now constructing Security Training and Test (SETT) facility which is new extended test-bed to make technical standards for physical protection systems. Future plan is to verify assessment zone setup methodology through applying to SETT facility. As doing so, KINAC will be able to establish reasonable technical standard for intrusion detection systems at the NPPs.

REFERENCES

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