Performance Test of CCTV in a Test Field

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1. Introduction

On April 12-13, 2010, US President Obama hosted a Nuclear Security Summit in Washington, DC, to enhance international cooperation to prevent nuclear terrorism, an issue which he has identified as the most immediate and extreme threat to global security. The Summit focused on the security of nuclear materials, nonproliferation, disarmament, and peaceful nuclear energy. At the summit, the Republic of Korea was chosen as the host of the next Summit in 2012. This series of events reflects the growing global interest on 'Nuclear Security' and as the host country of the next Nuclear Summit it is the time for Korea to strengthen the physical protection regime for nuclear facilities as a first step of securing its nuclear security capability. KINAC has been operating Test field as a mean of preparing solid backup data for reviewing and revising DBT (Design Basis Threat) and to test components of the conventional physical protection system. CCTV is a key component which is used worldwide for the assessment measure of alarms. In terms of performance test of CCTV, there are several elements such as image quality, coverage and mechanical features (speed of zoom-in-out, capture, angle shift etc.). Speaking of image quality acquired by the CCTV, the quality is subject to resolution, monitor specification, camera housing, camera mounting and lightening. Thus it is clear that performance tests on image quality should consider those factors and vary the factors respectively in order to verify the influence and the interaction among those. Nevertheless due to the restrictions of the current Test field, this paper focuses on the image quality through resolution test under the various lightening conditions

2. Description of CCTV

The picture above shows the most common CCTV model housed and mounted in a typical way. The image quality is varied by specifically resolution, sensitivity, color/gray scale, reflection on the surface, recording device, signal process, signal strength, monitor specification, camera housing, camera mounting and lightening.

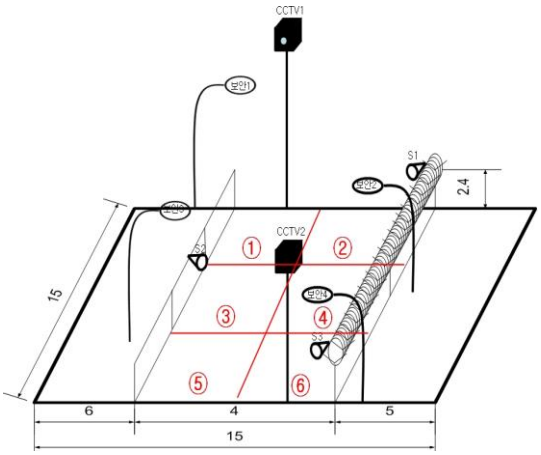
Camera housing should be designed to protect the camera against knocks, rain, snow, dust, sudden change of surrounding temperature and to make the camera have consistent performance within a guaranteed range of environmental condition. In a similar way, proper camera mounting should be encouraged to be a stable CCTV support as well as to secure the position which allows no interference and blind spot on the CCTV sight. When designing camera mounting, it should be carefully reviewed and considered that the mounting frame can be misused as a bridge for intrusion to defeat the physical protection system. Installing temper alarm is one of the precaution measures against this possibility. According to the guidelines of SNL (Sandia National Lab.), the recommended height of mounting is between 4.6 to 9.2m and higher than 8m if possible. The encouraged type of mounting is freestanding triangular towers with cross-member (picture below).

monitor size (inch)	distance from operators (m)
9	0.9 - 2.1
12	1.2 - 2.7
13	1.2 - 3.0
14	1.2 - 3.7
17	1.2 - 3.9
19-21	1.2 - 4.6
25	2.1 - 5.2
26	2.4 - 5.5

Lightening system is critical to have CCTV perform at night time. Lightening devices should be in upper position than camera not to intervene camera sight. Some lightening systems are turned on by alarms for some reasons such as energy saving purpose. Nevertheless if high security precaution is needed in the area or the facility, lightening system triggered by alarms should be avoided as it takes some time for lights to turn back on and for camera to adopt the brightness. In some cases, the angle of lightening causes the interference of the camera sight and this is the reason that the installation height and angle should be carefully reviewed before installation. The size of monitor is a key feature which affects overall quality of

image that an operator acquires. The abobe table is a guideline stating the recommendable monitor sizes corresponding to the distance from operators.

3. Design and outcome of the tests

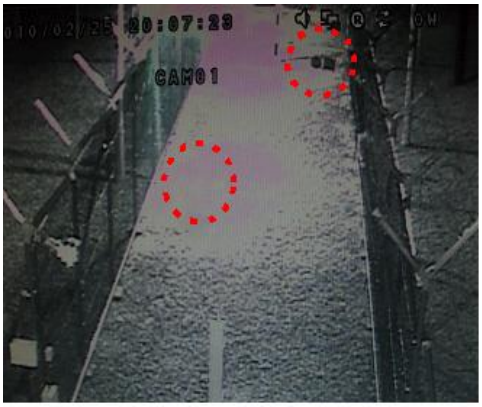


As mentioned in the introduction, the tests focus on the image quality. During the daytime, the image quality is consistent as long as the CCTV is in a normal operation. For this reason, nighttime tests were mainly conducted and this paper includes the outcome of those tests. As seen the picture above, three search lights and four security lights are installed in the test field. The coverage area of the CCTV is divided into six sectors and the light is turned on one by one from the security light No.1. The image from the monitor was observed and the level of illumination was measured each time a new light turned on. To verify the resolution of each image, the test targets were used. (picture below)

According to the recommendation of SNL, the average illuminance should exceed 10.7 lux and the desirable contrast ratio range is between 4:1 and 6:1. The picture below shows the monitor image under 27:1 contrast ratio. In this monitor image, it is possible to distinguish the black targets even though it is highly expected that we cannot distinguish black targets in accordance with the SNL recommendation.

<27:1 contrast ratio, 15 lux avg>

Next picture below was taken under 7:1 contrast ratio and 220 lux average illuminance. The contrast ratio has been much improved compared with the previous picture. For this reason, it was expected that the white target would appear on the monitor this time. Contrary to the expectation, the white targets got blurred. An assumption was made that the illuminace difference between the brightest spot and the darkest spot might be more decisive factor than the contrast ratio.



<6:1 contrast ratio, 220 lux avg >

The outcome stated on this paper is just part of the whole. More outcome would be mentioned and shared through the poster.

REFERENCES

[1] Technology Transfer Manual 'CCTV', Sandia National Laboratories, 1999
[2] 물리적방호 시스템에 관한 Test bed 설치 및 운영을 위한 절차서, KINAC, 2009