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Recommendation on the Design of a Detection System in a Physical Protection System

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1. Introduction

The major Physical Protection System(PPS) technology components are of a detection system, a delay system and response force. Each component should be designed to accomplish the goal of the PPS: 1) to protect against unauthorized nuclear material removal in use, storage and transport and 2) to protect against sabotage of nuclear material or facilities. A detection system consists of intrusion detection sensors and CCTV system [1, 2].

The purpose of this study is to provide and recommend the consideration for the design of a detection system in a PPS.

2. PPS overview

In this section, the major technologies in the design of a PPS will be introduced. A system may be defined as an integration of components or elements designed to achieve an objective according to the plan which the facility operators have previously made. The ultimate objective of a PPS is preventing the accomplishment of overt or covert malevolent actions. A PPS must accomplish its objectives by a combination of detection, delay, and response.

2.1 Detection system

A detection system can be used for sensing an intrusion in the perimeter of a facility whether it is exterior or interior. The integration of individual sensors into a perimeter system must consider specific design goals, the effects of physical and environmental conditions, and the interaction of the perimeter system with a balanced and integrated PPS. All the sensors will be evaluated by the characteristics: probability of detection, nuisance alarm rate, and vulnerability to defeat [3].

2.2 Delay system

Delay is the slowing down of adversary progress. Delay can be accomplished by barriers, locks and activated delays. The protective force can be considered elements of delay if they are in fixed and well-protected positions. The measure of delay effectiveness is the time required by the adversary to bypass each delay element. Delay before detection is primarily a deterrent [3].

2.3. Response force

Response consists of interruption and neutralization. Interruption is a sufficient number of response force personnel arriving at the appropriate location to stop intruders. Neutralization is defined as the actions of the response force when facing against the intruders [3].

3. Considerations for components and elements of a detection system in domestic installation

3.1 Intrusion detection system

There are several considerations for installing the system: 1) detection zone preparation should be taken into account according to characteristics of sensors such as infrared, E-field, H-field, optical fiber, microwave sensor. To provide excellent detection, sensors require that the grade be planar and even, especially for good crawl detection. One example for microwave sensors installation from Sandia experiments will be shown as follow: The terrain should be flat, with no more than +0, -15cm deviation from a plane drawn through the offset points or crossover points directly in front of the transmitter and receiver of the zone. 2) Weather consideration should be taken into account according to all the sensors' characteristics. The major factors which can cause the problem in good detection are snow, rain, wind and can be generating the nuisance alarm. The sensitivity of the sensors should be reduced to get rid of these nuisance alarms. 3) Periodic performance testing should be taken into account. It is very good for guard to do small test on petrol of the PPS such as touching and walking at the near detection zone to make sure the good detection. The following performance tests of each zone should be conducted while monitoring the output relay for the presence of an alarm condition: Initial walk, Run, Shuffle walk, Normal walk, Crawling intruder, Sphere target test. These tests will be at least once a year because the sensors will be degraded as the environmental conditions are changed [4, 5, 6].

3.2 CCTV system (Video alarm system)

The purpose of a CCTV system is assessment which is essential to identify the cause of an alarm and to determine if an alarm is a threat or nuisance. The system should be cooperated with the intrusion detection system to cover the detection zone against intruders. The components of a CCTV system are shown in Figure1.

It is necessary to consider the relationships between the CCTV, the intrusion sensors and the display system.

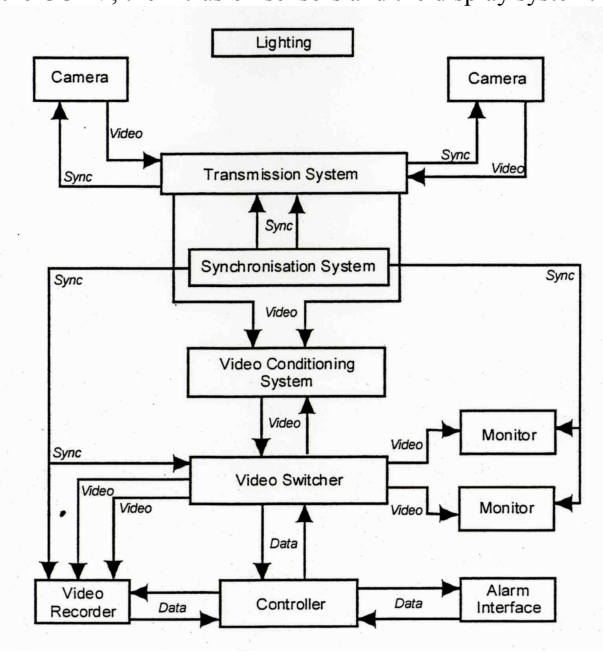

Figure 1. Components of alarm assessment systems.

One requirement of a perimeter assessment system is to display as much as possible of the clear zone including fences. For accomplishing the requirement, the spacing between the fences which are uniform, a minimum width for the clear zone, grading or removal of vegetation from the clear zone and adequate area for illumination should be required [4]. For example, The resolution limited by field of view of CCTV camera is based on experimental data from Sandia report to classify a 30cm target(crawler intruder) and located where the horizontal field-of-view is 30cm wide

4. Further consideration

In the domestic nuclear facilities, a detection system is installed with the compliance to the national law for the PPS. But there are no criteria of PPS installations in nuclear facilities. We have been doing R&D for establishing the criteria for them. This study is on going process. To apply those considerations directly to the facility's PPS, a lot of operational data in the detection system will be needed and the criteria will be completed for the national law.

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