The Senstar LM100 Hybrid Perimeter Intrusion Detection and Intelligent Lighting System protecting an electrical storage yard directly adjacent residential housing. The targeted lighting illuminates the perimeter while limiting light trespassing onto the houses on the right. *(All photos courtesy of Senstar)*

Intelligent Perimeter Lighting for Electrical Substations

Next-generation security lighting dramatically reduces light pollution and operating costs while introducing new capabilities

By Todd Brisebois

Security lighting is a well-established method of deterring theft and vandalism at electrical substations and other high-value sites. While lighting alone won't stop a determined intruder, a well-lit site can discourage those who would hide under the cover of darkness, assist video surveillance operators by improving visual assessment abilities, and provide better visibility for on-site workers.

Making lighting "intelligent" by adding embedded sensors and/or other intelligence features, not only makes it a more effective deterrent, but can also allow it to actively detect and respond to intrusion attempts. For example, strobing or changing intensity in reaction to intrusion attempts or triggering alarms and automatically selecting applicable camera views in video management software.

A Better Approach to Lighting

Despite being widely used, indiscriminate security lighting has substantial costs and some drawbacks. Traditional technologies such as high-pressure sodium (HPS) and metal halide (MH) are expensive to install, require periodic maintenance, and cannot be switched on and off rapidly. As a result, they usually remain on all night, following a simple time-based schedule. In addition, these technologies, as well as their newer LED-based replacement fixtures, generate light pollution due
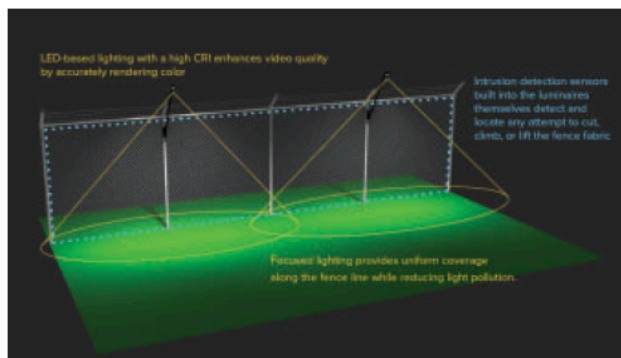
The Senstar LM100 Hybrid Perimeter Intrusion Detection and Intelligent Lighting System limits its coverage to where it is needed, while embedded accelerometers detect attempts to cut, climb, or lift the fence fabric.

to their wide coverage area.

Light pollution can be a significant concern for substations located near sensitive areas like protected nature reserves or airports. For sites adjacent residential areas, the use of indiscriminate high-powered lighting can lead to complaints and infringe upon local or state bylaws and regulations.

The first step to reducing light pollution is to use low voltage engineered LED lighting that directs light downwards and along the fence line, thus meeting the International Dark Sky

Association's (darksky.org) recommendations of using targeted lighting only where needed. Targeted, top-shielded luminaires minimize light escaping upwards or horizontally. In addition, lights must be dimmable and minimize blue light emissions.

For substation operators, using IDA-compliant perimeter lighting doesn't just make environmental sense — there are measurable economic benefits as well. The following chart compares the relative cost of different lighting technologies used to illuminate a 600 m (0.4 mi) perimeter.

TOTAL COST OF OWNERSHIP (TCO) OF THE SENSTAR LM100 COMPARED TO OTHER SECURITY LIGHTING SOLUTIONS.

Electricity cost assumes 11¢/kWh.
† Based on 30-foot lighting standard used for HPS, MH, MV and LED area lighting.
†† Civil cost at $20/hour for installation.

- 6-year operational costs
- 6-year maintenance costs
- Supply/installation costs

Maintenance & operating costs:
MV = $84,225
MH = $118,228
HPS = $55,784
LED = $5,023
Intelligent lighting = $620
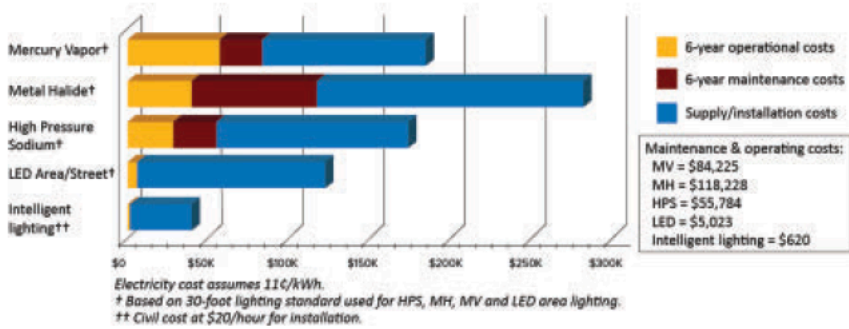
Security Starts at the Perimeter

The first step of any security plan is to deter intruders. While a fence alone provides an initial barrier, it can easily be cut, climbed, or otherwise broken through. An effective security system should immediately alert security to exactly when and where an intrusion is occurring, as well as communicate to intruders that their presence is known, they are being watched, and response forces may already be dispatched. That's why fence-mounted sensors and other perimeter intrusion detection systems are increasingly being used to protect electrical sites. They are field-proven, difficult to defeat, and work reliably in all weather conditions.

When an intruder is detected, the generated alarm (which includes intrusion zone or precise location) can be used to trigger other on-site security resources, including PTZ cameras and deterrent devices such as sirens, loudspeakers, or other security lights. The system can be monitored by centralized security personnel, enabling them to assess the situation remotely and dispatch a response if required.

When intelligent security lighting is added, it expands the capabilities of perimeter intrusion detection systems by enabling additional deterrent and assessment capabilities:

Basic site or perimeter illumination — Discourages would-be intruders while enhancing the effectiveness of camera surveillance systems. The wide light spectrum of newer LED-based products provides a better Color Rendering Index (CRI) value that helps remote operators describe and identify intruders for immediate response or post-incident investigation. In addition, uniform, hotspot-free lighting along the perimeter, enables high quality video to be obtained with lower performance cameras. For organizations with tens or hundreds of sites, the resulting savings in equipment costs can be substantial.

Immediate and visible alarms — Intelligent lighting can provide localized instant-on, intensity adjustment, or alarm strobe features, indicating to would-be

Video surveillance footage showing a site protected by both an outdoor people tracking video analytic and the Senstar LM100 Hybrid Perimeter Intrusion Detection and Intelligent Lighting System.

intruders that they are detected, and their exact location is known (and presumably being recorded by the site's security cameras).

Avoid Complacency by Minimizing Nuisance Alarms

Avoiding nuisance alarms generated by weather, animals, and lawful people is critical to the overall success of a perimeter security system. Too many nuisance alarms may lead security personnel to become complacent, ignoring valid alarms or hesitating to initiate a response until it is too late. In addition, the cost to send response forces to a remote site may prohibit a response unless the threat is validated.

- A perimeter security system should be designed from the outset to minimize nuisance alarms.
- Ranging data from sensors is used to recognize and compensate for site-wide environmental disturbances like high winds or rain.
- Alarm algorithms are optimized so that alarms are generated only from realistic intrusion attempts (e.g. a ball hitting the fence doesn't trigger an alarm).
- Sensors are designed and tested for reliable operation in extreme environments (e.g. −40 to +70°C/−40 to 158°F).
- Maintenance staff can use the precision ranging to quickly find and resolve problematic areas (for example, an area with loose fence fabric).
- Alarms can be quickly validated by remote personnel (e.g. automatic camera call-up).

Effective, Multi-Layer Security

Bringing intelligence to the perimeter enables new applications and enhanced multi-layer security, especially when video analytics are used.

For example, consider a site where a people tracking analytic monitors the immediate surrounding area. Under normal operation, the video surveillance system records a low-bandwidth stream. When the analytic detects the movement of people near the perimeter, the video management software switches to a higher quality stream and increases the intensity of the perimeter lighting. The improved lighting maximizes the performance of the analytic software and ensures potential intruders are recorded (and ideally deterred) well before an intrusion is attempted. If the area has a relatively high amount of nearby legitimate human activity (for example, a public sidewalk near the substation), alarms are only generated when a disturbance occurs on the actual fence. This results in reduced operator overload, as the number of false and nuisance alarms are dramatically reduced.

Moving Forward with Better Technology

The mainstream adoption of low-voltage LED-based lighting combined with low-cost embedded processors has revolutionized the lighting industry, with new applications being introduced every day. The physical security market is benefiting from these advancements and can expect many new cost-saving products, all which can benefit from mature detection and nuisance alarm rejection algorithms.

Intelligent lighting products may very well lead the next generation of perimeter security systems, offering strong deterrence and detection features while enhancing existing camera surveillance systems. **UP**

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