With the modernization of threats, it is not only necessary to protect substations against animals, copper thieves and snakes, but also to include sniper fire, ballistics and blast protection

ABSTRACT

With new threats endangering the safety of substations, critical infrastructure protection in substations has come to include sniper fire, ballistics and blast protection. Safe by Design approach allows that all types of design safety and performance criteria – fire, blast, impact, wind – cross over from safety to security. In this article Critical Infrastructure Protection innovations and strategy options are discussed, with a focus on ballistic fire barriers that provide both safety and security at critical facilities.

KEYWORDS

ballistic fire barriers, blast barriers, critical infrastructure protection, Safe by Design, UL 752, NFPA 851

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Ballistic fire barriers - Part I

Critical Infrastructure Protection for substations and transformers

Safe by Design is the process in which potential threats and hazards are identified, and specifications for protection are written and deployed to mitigate them

Major US substation protected by UL 752 Level 8 ballistic fire barriers installed to NFPA 851 Line of Sight

Introduction

With the modernization of threats, Critical Infrastructure Protection (CIP) in substations has come to include not only protection against animals, copper thieves and snakes but now includes sniper fire, ballistics and blast protection. All types of design safety and performance criteria – fire, blast, impact, wind – can now cross over from safety to security using the Safe by Design approach. This article highlights innovations and options for strategy and planning for critical infrastructure protection using ballistic fire barriers for hardening at critical facilities providing both safety and security.

Once a threat is identified, the next step is to source tested solutions. There is no room for error in Safe by Design projects. The goal and objective is to eliminate and mitigate a threat and the best protection an engineer has to offer is a UL Tested Design.

Safe by Design approach for using barriers – Synopsis

Using the Safe by Design process for a ballistic fire barrier project can be very effective for protecting transformers, switches and controls. Safe by Design is the process in which potential threats and hazards are identified and specifications for protection are written and deployed to mitigate those threats and hazards using tested designs. Projects of this type can include a highly-engineered series of barriers and various configurations. To protect the nation's infrastructure, installations need heights up to 18 meters (60 feet) and have to withstand wind loads of 249 kilometers per hour (155 miles per hour) – the equivalent of a Category Five hurricane. This is quite a structural design, but it delivers a tested assembly level of protection. Barriers near transformers and some critical infrastructure should be installed to meet National Fire Protection Association (NFPA) 851 [1] line-of-sight provisions to properly protect against projectiles. Areas that are identified as a threat zone can include adjacent hillsides and rail yards, banked transformers and hazardous materials, and process areas. Additionally, barriers need to be tested to shield from transformer fires and blast, which burns

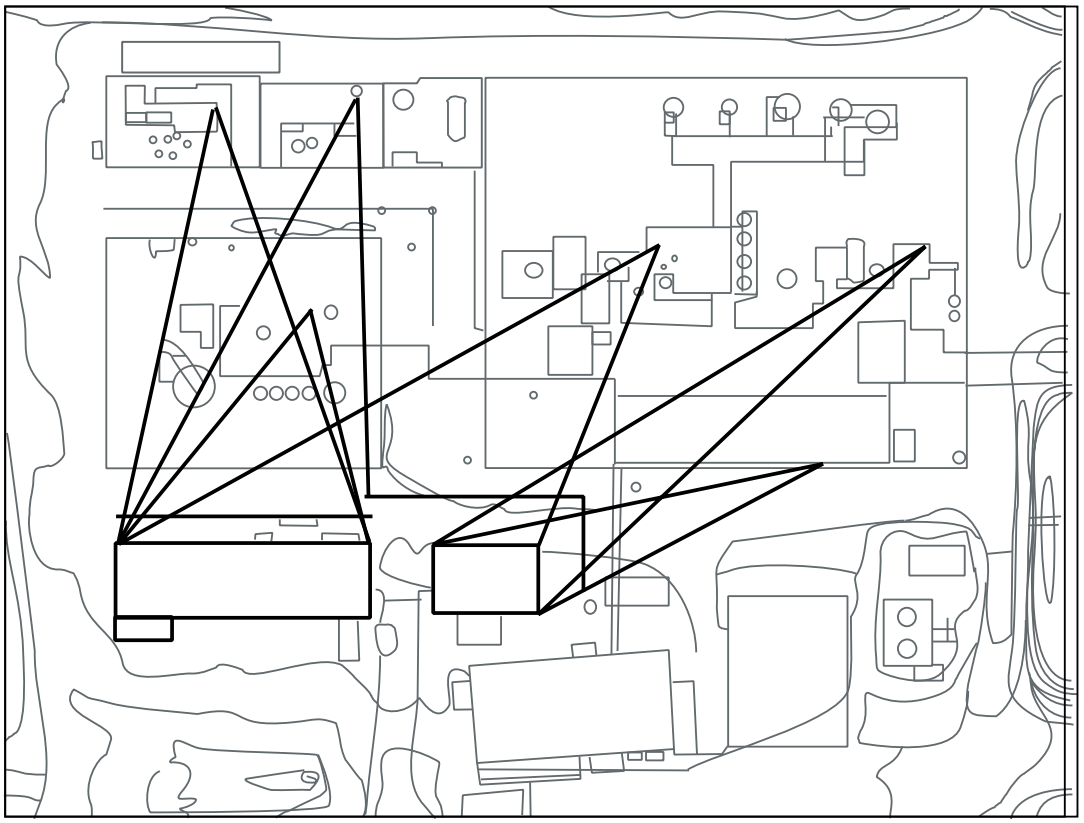
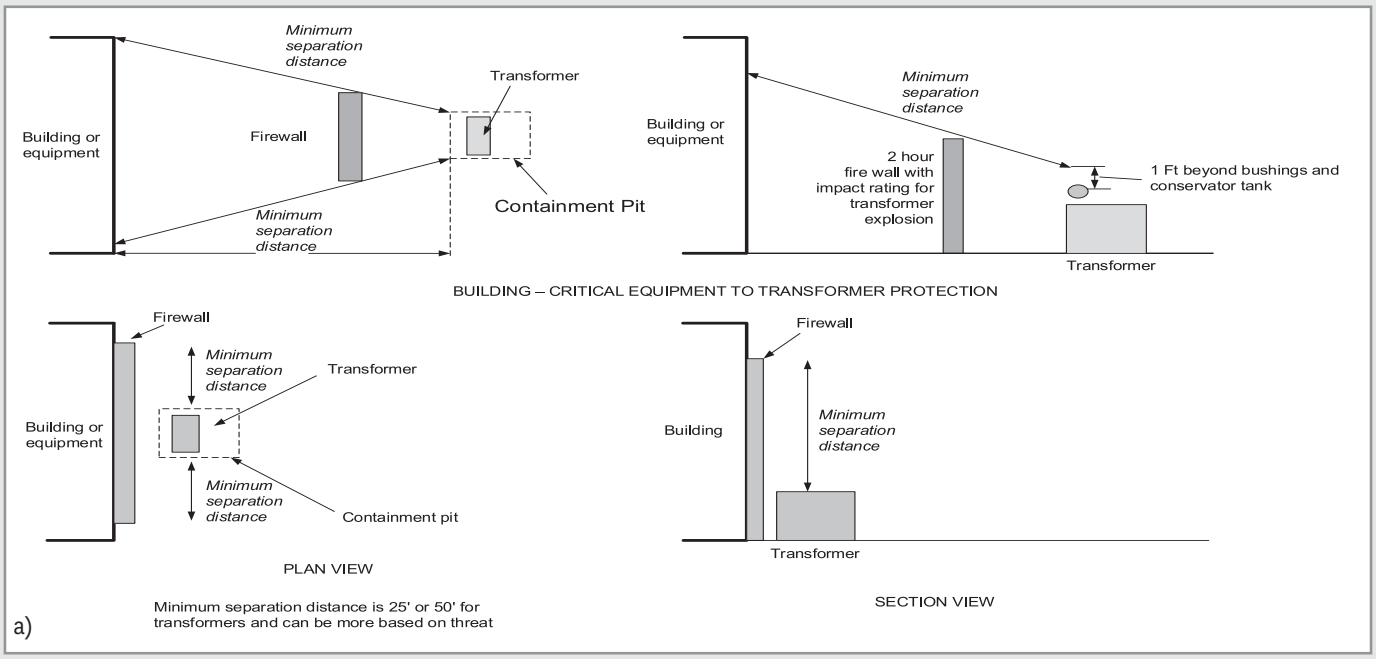


Figure 1. Site threat assessment diagram

Figure 2. UL 752 tested ballistic fire barriers installed to NFPA 851



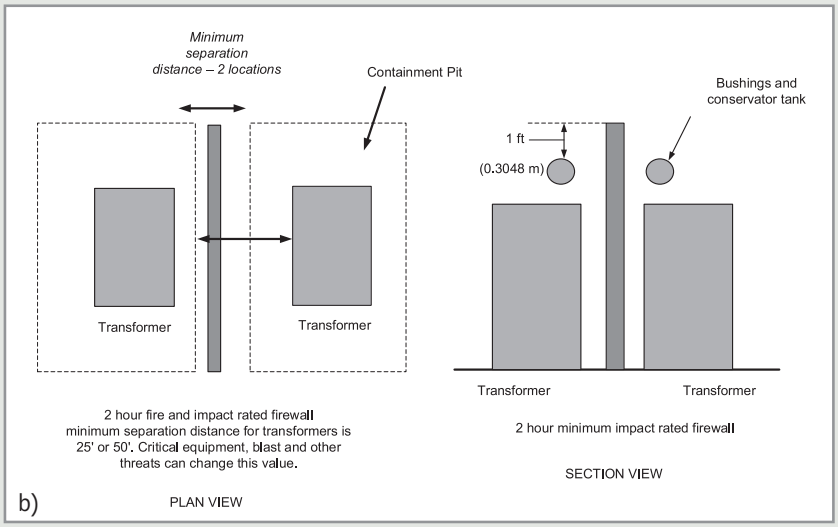


Figure 3. a) Transformer to building or critical equipment; b) transformer separations and protection

longer and hotter than traditional fires. Significantly, ballistic installations must meet the Underwriter Laboratories (UL) 752 Level 8 Standard [2] to resist 7.62 mm Armor Piercing Rounds. Barriers constructed to Level 8 standards protect electric power facilities and CIP from sniper incidents. It is recommended that both the utilities' engineering team and the safety and security groups are educated in these standards to benefit both groups' goals as well as deliver Safe by Design to your critical facilities and mitigate hazards and threats.

Protection

When looking at Safe by Design innovations it is important to remember that all substations are different. Geography, climate, topography, layout, usable space and general conditions all vary from station to station. However, there are traits and trends that need to be evaluated when considering physical protection using barriers and walls for protection. Engineers know that adding untested wall designs for ballistics may not provide any protection at all, and that more walls does not necessarily imply more protection. Specification and placement of protection walls and separations are all part of the design process and critical to the Safe by Design approach. The selective use of UL tested systems, including barriers, shields and assemblies in a "protection strategy", can provide maximum benefit at minimum cost and protect your liability at the

Table 1. Basic information required for building an effective ballistics and barrier shield program

What are you looking to protect?	What are you protecting from?
Substation	Snipers
Transformers	Fire
Buildings	Blast
Switches and controls	Impact
Tank farms	Wind
Pipe lines	Seismic
Critical equipment	Hunters and others

same time. The Safe by Design approach controls liability and includes these simple steps:

1. Identify – what is being protected and what is the threat
2. Specify – performance criteria needed for protection
3. Deploy – eliminate threats and mitigate hazards

Table 1 outlines a few basics necessary to build an effective ballistics and barrier shield program.

Physical site assessment – Identify the threat

The physical site assessment for fire barriers and security walls utilizes a Line of Sight standard from National Fire Protection Association (NFPA) to help plan protection against impact from projectiles, transformer explosion or blast. A transformer explosion can send parts and shrapnel over 75 meters (250 feet) at an impact equivalent to a .44 magnum lead at 453 meters per second (1485 feet per second), the standard of UL Level 3 ballistics.

Most transformer fires are preceded by an explosion and followed by collateral damage. The energy industry is using standards and codes available to help define threats and deliver solutions. These same standards can provide the basis and help direct the site threat assessment so that under writable, tested solutions can be delivered. As an example, insurance rates, deductibles and retention monies can be better negotiated by the utility if assets are protected with UL 752 ballistic tested barriers installed to NFPA 850 Line of Sight guidelines [3]. This method minimizes risk and loss with a third party tested and under writable solution that can influence insurance carriers, stockholders and insurance rates.

When protecting critical infrastructure and controls, hardening with ballistics rated covers and shields is an option and sometimes can be incorporated into the structure design. In some cases, this can allow you to minimize the use of external barriers and shields. When planning barrier and shield design, using tested ballistics systems and assemblies can assure the protection eliminates the threat and is installed to a standard.

All substations are different in terms of geography, climate, topography, layout, usable space and general conditions

Side Note: Concrete barriers cannot be moved and only extend to 9.1 meters (30 feet) tall. Concrete barriers will not pass a fire test and there are no UL 752 tested concrete barriers for any level of ballistics – they do not hold up to the five shots required. The new, innovative design barriers are UL 752 tested for ballistics and fire [2], are modular and can be installed to 18.6 meters (61 feet) tall at an unlimited length.

Bibliography

[1] NFPA 851, Guidelines for Transformer Separations

[2] Underwriters Laboratories 752, Standard for Bullet Resistant Equipment

[3] NFPA 850, Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations, 2010 Edition

The physical site assessment utilizes a Line of Sight standard from NFPA for protection against impact from projectiles, transformer explosion or blast

Author

John P. Sinisi, Industrial Engineer with BallisticFireBarrier.com, has over 30 years of experience in safety, security and inspection. His expertise in containment, fire barriers and fire stopping brings a Safe by Design approach to threat assessment and mitigation for critical infrastructure. In addition to numerous publications and serving 6 years as Education Chair for the International Fire Stop Council, John holds a US Patent and has work experience in Corporate Safety at United Technologies, BASF, Anheuser-Busch and AGIP Italia before starting his firm in 1999. Recent projects include education programs at NERC and IEEE, threat assessment for major utilities and the design, deployment and installation of the largest UL 752 Level 8 tested ballistic fire barrier ever installed in the US, protecting a major US substation.