SECURITON

Mobile Power Generators

SecuriHeat ADW

Case study | SecuriHeat ADW | Mobile Power Generators

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1 Introduction

Today, commercial mobile power generators range from truck-mounted or containerised generators (power generation units) to a complete mobile power plant which can be loaded on trailers for rapid deployment. The mobile power generators market is worth billions of US dollars with a high growth trajectory. The Middle East and Africa account for largest share of the total market with over 30%.

As the uses of mobile power generators grow, rigid fire safety and prevention measures must be implemented due to their fire hazards and risk profile and the need to safeguard these high value assets as an integral part of critical infrastructure. Examples of risks include high current electrical cabling, and the presence of fuel and lubricants. The risks and hazards resemble those of a conventional thermal power plant while being relatively smaller and in an extremely compact environment.

The operating conditions for mobile power generators can be challenging. In certain areas, such as mining or oil and gas sites, a corrosive environment can affect the performance of electrical and electronic systems. Overheating induced fire ignition can happen around the generator that can quickly spread to the nearby electrical distribution and control cabinets inside the container.

Other challenges such as the ongoing service and maintenance for the installed fire detection systems on the move, and often positioned in remote, unmanned areas, must also be considered. Unnecessary site visits to attend frequent service needs, even just caused by false alarms, can have a negative impact on suitability and cost of a fire detection system for such unique applications.

Reliable, low maintenance fire detection is therefore a critical part of a fire engineering solution to address these challenges. A well-designed and reliable fire detection system provides risk mitigation to potentially prevent a fire from happening or developing out of control before orderly system shutdowns can be put in motion. A staged fire alert and alarm can also facilitate the local site or nearby fire services response well before the situation develops into one that will cause loss of critical power and ultimately the permanent loss of the generator. However, smoke detection is generally unsuitable as the generators feature a combustion engine which itself gives off exhaust fumes that are, effectively, smoke.

Securiton’s SecuriHeat ADW line-type heat detector (LTHD) offers a robust, reliable and quick-acting fire detection system suited to all types of harsh industrial and challenging environments. SecuriHeat ADW is a sensing tube system that has been specially designed to meet EN 54-22 [1], ANSI/UL 521 [2] and FM 3210 [3] standards. The sensing tube material can be copper or stainless steel that can be installed in the most challenging environments. Some key advantages include its high sensitivity; its real-time system fault self-check and alarm; and the fact that it is free of routine maintenance, and easy to install.

The purpose of this Case Study is to provide fire safety and protection consultants, qualified fire system specifiers, design engineers or technicians, with recommendations for the application and use of SecuriHeat ADW LTHD detectors to protect mobile power generators of varying size and design. A key design objective is to enhance fire detection methods to provide risk-based object and area protection within containerised or truck and trailer-mount mobile power generator units and mitigate risks through best fire prevention practices.

Where applicable, the Case Study also provides key requirements on Inspection, Testing and Maintenance (ITM) of SecuriHeat ADW; and world-class technical and application support offered by Securiton through its headquarters teams in Europe and its vast global network of local employees and distribution partners.

2 Aspects of fire safety and prevention

Commercial power generators are generally segmented into portable (transportable) and stationary. They are fuelled predominantly with diesel or natural gas/LPG[1]. These mobile generators are not meant to be installed permanently. They work in stand-alone applications within a defined functional period, depending on a supply of fuel. Mobile power generation is a rapidly growing industry, due especially to the rising demand for reliable power sources for remote area regional electrification, natural disaster response, construction projects, temporary sports or entertainment events, off-grid power supply to critical infrastructure, and oil & gas exploration. Modular (containerised) and mobile type (truck or trailer-mount) power generators are both gaining popularity. In many instances, they are an integral part of critical infrastructure for a wide range of industry and applications.

The mobile power generators (plants) market as a whole was valued at US $1.24 bn in 2023, with an estimated growth of 4.6% over the forecast period. The Middle East and Africa account for largest share of over 30% of the total market.

As critical uses of mobile power generators grow, the rigid fire safety and prevention measures that apply to stationary power plants are increasingly being implemented to safeguard these high value assets as integral part of critical infrastructure.

2.1 Mobile power generators

In comparison to conventional power stations, mobile power generators (known as mobile power plants when power rating exceeds 1 MW) are now also widely used for long-term energy supply and immediate electricity supply in areas across the globe. They provide a modular, sturdy power generation infrastructure. Mobile power generators are compact in size and relatively light in weight. They must also be highly adaptable to the natural environments where they may be located.

The focus of this Case Study covers the modular type of mobile power generators with a power rating up to 1 MW. However, the concept of fire detection and protection of these critical infrastructure remain the same for larger sized mobile power plants. Typical application scenarios are:

- Mobile power generators providing back-up power for critical infrastructure such as data centres, healthcare, manufacturing or water treatment; and off-grid telecommunication GMS towers (Figure 1 (a)).
- Powering sports and recreation events, for evening lighting or temporary power supply for large events such as the Olympic Games (Figure 1 (b)).
- Transportable truck-mounted mobile power generators or trailer-based large mobile power plants used for oil and mining field power, remote power and regional electrification, and emergencies such as natural disasters (Figure 1 (c)).

[1] LPG: Liquefied Petroleum Gas

(a) Use for critical infrastructure such as data centres (left) and Off-grid telecommunication GMS towers (right)

(b) Uses in sports and recreation dedicated for evening lightings (left) or temporary power supply for Olympic games (right)

(c) Trailer-based power generator/plant (used for oil field power, remote power, and emergencies such as natural disasters)

Figure 1 Mobile Power Generators (Plants)

2.2 Fire risk, consequence and safety

Although on a smaller and much more compact scale, mobile power generators pose similar fire hazards and risks to standard power generation and its transmission and distribution infrastructure (refer to Securiton AG Design Guides [4] [5]). Unique fire hazards, risks and consequences from fire damage from power generation facilities, coupled with difficult environments, are addressed through international and national codes and standards (e.g. NFPA 850 [6] and NFPA 110 [7]), risk management and insurance loss prevention guidelines (e.g. AXA XL [8] and FM Global [9] [10]).

However, there are also fire risks specifically related to mobile power generators:

- Inside a rather compact space, there are cables with high current, potentially exceeding 150 A and running 24/7. The components involve electrical and electronic equipment, and cabling connectors, that are vulnerable to fire due to premature corrosion and high energy current within isolated areas and concealed spaces.
- Mobile power generators should only be placed in well-ventilated areas to prevent the buildup of carbon monoxide and other harmful gases. They are exposed fully to local climate conditions with extreme high or low temperatures, and even corrosive environments.
- Ignition sources can include faulty electrical equipment, generator heat, friction, any overheating and fuel leaks.
- Fuel sources for a fire can include combustible and flammable liquids (e.g. hydraulic fluid, diesel oil, compressor, grease, and lubricating oil), combustible gases, or wiring insulation. These highly flammable materials are

contained within the confined space of a container in close proximity to potential ignition sources such as overheated mechanical components (hot surfaces) and electrical connections that could fail.
- Slower growth fires (mechanical and electrical malfunction) are the primary causes of fire, originated from areas of high voltage cable networks, switchgear and control equipment, arcing and static electrical charge, mechanical wear and high heat loads, flying sparks from mechanical brakes as well as high pressure hydraulic systems.
- Once a fire is ignited inside a compact space such as a container, it can rapidly escalate due to the high density of equipment and cabling, favoured by ventilation openings with enhancement of oxygen supply, hence, the fire growth.
- A remote and unmanned facility can render emergency response to a fire critically time sensitive. In many cases, generators rely on fully automatic fire safety systems from detection to suppression to contain and minimise fire damages.

With a reliable fire detection system for mobile power generators, fire incidents can be managed to avoid or minimise operation interruption and damages. Unnecessary power-downs may also be avoided. Even as the fire situation progresses, fire services or nearby emergency response teams can be notified automatically and arrive at the scene much earlier before the fire spreads from the fire of origin to the surrounding buildings or other mobile power generator units.

3 Challenges to reliable fire detection

The primary concerns of fire safety for mobile power generators are:
- Operating conditions can be challenging. Conditions in which the generators themselves are required to be tested in a temperature range, typically -15 °C (5 °F) to 49 °C (120 °F) for starting and operation [11]. In other areas, such as mining sites, corrosive air can affect the performance of electrical and electronic systems.
- Overheating-induced fire ignition can happen around the generator that can quickly spread to the nearby electrical distribution and control cabinets inside the container.
- Danger of deflagrations or even explosion with a fire developing in such as compact space if proper ventilation cannot be provided.
- Fire could also spread beyond the container itself on to the hosting truck or trailer, and beyond.
- The presence of fumes and the related need for strong ventilation makes smoke detection unviable.

With few exceptions, mobile power generators are designed for outdoor use, hence fire detection and protection systems can potentially be subjected to the seasonal temperature fluctuations and weather elements. In winter, the ambient temperature could fall to -30°C (-22°F) or lower. In summer, temperatures could be well over 40°C (104°F). Fire safety products and their performance need to be highly reliable and consistent regardless of environmental conditions.

SecuriHeat ADW LTHD, with its sensing tube system, is a cost-effective solution for various types of mobile power generators and their applications that often require only a single fire zone coverage.

Challenge	Securiton advantages
Heat and fumes and forced or natural ventilation	Use of SecuriHeat AWD for rate-of-rise detection combined with fixed threshold heat detection.
Wide ambient temperature range	SecuriHeat ADW operating temperature range: main control unit -30 to +70°C (-22 to +158°F), sensing tube -40°C to +300°C (-40 to +572°F)
Need for ‘close-to-object’ detection	SecuriHeat ADW sensing tube can be positioned in virtually all environments. The sensing tube can be bent to shape to cater for open space and object localised detection.
Obstructed or difficult access	SecuriHeat ADW sensing tube located in the protected areas while the main detector unit can be installed in a convenient location.
False alarms	SecuriHeat AWD adopt unique highly sensitive rate-of-rise detection combined with fixed threshold alarm for maximum reliability, allowing to be integrated with clean agent, dry powder or sprinkler actuation.
Low TCO and easy maintenance	SecuriHeat ADW control units have a long service life, a fully automatic self-test algorithm. The sensing tube is maintenance-free.

Table 1 Challenges to and solutions for mobile power generators protection with reliable fire detection

4 Optimised design & use case

SecuriHeat ADW can be used as the main fire detection method for all types of mobile power generators. The cost-effective SecuriHeat ADW 535 is an integrating line type heat detector with a response behaviour based on heat differential and/or maximum heat. It is a reliable, fit-for-purpose fire safety solution to protect mobile power generators that require single fire zone coverage. The self-check feature and the periodic, automatic test are other advantages for use in applications where the legally prescribed functional and maintenance checks are performed at often remote and unmanned sites.

4.1 Design codes of practices

Building codes and fire codes in relevant jurisdictions, such as the International Building Code (IBC) [12] and NFPA 1 [13]), stipulate general occupancy classification and fire safety measures concerning a power generation plant or similar category of building use. FM's data sheet 5-23 outlines the types, operation, maintenance, and protection of emergency and standby power systems, excluding those used for regular power supply [14]. Whether a standalone power generation plant or mobile power generators, safety codes such as general electrical safety codes (e.g. IEEE National Electrical Safety Code and NFPA 70 National Electric Code) apply.

In terms of location requirements of a fire protection system, such as sprinklers or clean agent suppression system, other codes and industry codes of practice (e.g., FM Global and AXA XL Risk Consulting [15] and NFPA 13 [16]), outline where and how such fire protection systems are installed. Design and operation considerations focus on the use of individual buildings or areas that fulfil the process of power generation from a source of energy. For example, ISO ICS[2] 27 address aspects of energy and heat transfer engineering, with specific subset of ISO standards and IWA's[3] serve as technical guidelines to cover each category of power plant, for example ICS 27.100 for power stations in general, including thermal power plants that require large turbines and generators to turn thermal heat into electricity.

Performance-based Design (PBD) is typically implemented when elements of fire safety and protection system design are not covered in the prescriptive codes among others due to unique building structure, environmental conditions, added detection for early warning or extended egress considerations [17].

A PBD approach is commonly adopted for either of the following:
1. As a means to determine equivalency to a prescriptive code or standard
2. As an approach to achieve broadly defined fire safety goals and objectives

While codes and standards may not explicitly prescribe the exact fire safety and protection measures for mobile power generators, a risk-informed PBD method is a fitting fire engineering methodology to devise a suitable fire detection solution, taking into account specific risk areas for both open space and object-oriented fire safety design.

An adequate fire detection system that automatically alarms local fire services can make a huge difference in minimising the damage that a potential fire can cause. The ability to detect and alert early also allows local site management or facility operators to control the initial outbreak or to remove potential hazards that would help the fire grow. Reliable fire detection solution can be optimised with detection earlier to prevent avoidable business interruption, as well as a low TCO[4] over the product lifecycle.

4.2 Design criteria SecuriHeat ADW

This chapter describes design criteria using SecuriHeat ADW in mobile power generators. SecuriHeat detects temperature changes and alerts almost instantly to any potential fire incident or developing fire event. SecuriHeat ADW is a sealed system that is immune to dust and moisture and can resist chemicals.

Table 2 illustrates how LTHD Fire Detection system performance and other design parameters such as environmental conditions and typical applications, are defined. Note that SecuriHeat AWD products meet all response classes and all environment groups per EN 54-22 [1]; and supported key temperature classes and range of spacing options per NFPA 72 [18].

[2] ICS: International Classification for Standards
[3] IWA: International Workshop Agreements
[4] TCO: Total Cost of Ownership (of Reliable Fire Detection system)

Design Parameters	BS/EN 54-22 [1][5]		NFPA 72 [18]	
Class vs. Detection Range	**Response Class**	**Detection Range °C (°F)**	**Temperature Class**	**Response Temperature °C (°F)**
	A1	54 - 65 (129 - 149)	Ordinary	58 - 79 (136 - 174)
	A2	54 - 70 (129 - 158)	Intermediate	80 - 121 (176 - 250)
	B	69 - 85 (156 - 185)	High	122 - 162 (252 - 324)
	C	84 - 100 (183 - 212)		
	D	99 - 115 (210 - 239)		
	E	114 - 130 (237 - 266)		
	F	129 - 145 (264 - 293)		
	G	144 - 160 (291 - 320)		
Environment Group	**Environment Group**	**Temperature Range °C (°F)**	n/a	
	(E)1	-5 to +40 (+23 to +104)		
	(E)2	-10 to +55 (+14 to +131)		
	(E)3	-25 to +70 (-13 to +158)		
Typical Applications and Boundary Conditions	E1: Indoor; Stable and Clean Conditions; Commercial and industrial E2: Indoor; Varying and polluted environment; Commercial and industrial E3: Outdoor; Harsh conditions			

Table 2 Design and performance parameters for LTHD per codes and standards

A summary of SecuriHeat ADW products key performance parameters is shown in Table 3 below.

Model	Key performance parameters
SecuriHeat ADW Classes and tube	
Classes	See Table 2
Sensing tube length	2 x 10 - 200 m (33 - 656 ft)[6]
Tube type	Copper (TU 5/4 Cu), stainless steel (TU 5/4 SS)
Rating and operational data	
IP device approvals	IP65
Operating temperature (main control unit)	-30 to +70°C (-22 to +158°F)
Operating temperature (sensing tubes)	Copper/stainless steel: -40 to +300°C (-40 to +572°F)
# of Relays: Built-in (Expanded – Module)	2 (10 – 2 x RIM36)
Product Type Approval Standards and compliance level	
EN 54-22	Classes A1I to GI
UL 521 – ULC-S530-M91	per EN 54-22 Classes A1I to GI
FM 3210 / NFPA 72	Classes Ordinary, Intermediate, High

Table 3 SecuriHeat ADW product key performance parameters

[5] ISO 7240-22 is derived from BS/EN 54-22.
[6] For EN 54-22 designs the sensing tube length is limited to 2 x 10 - 140 m (33 - 459 ft)

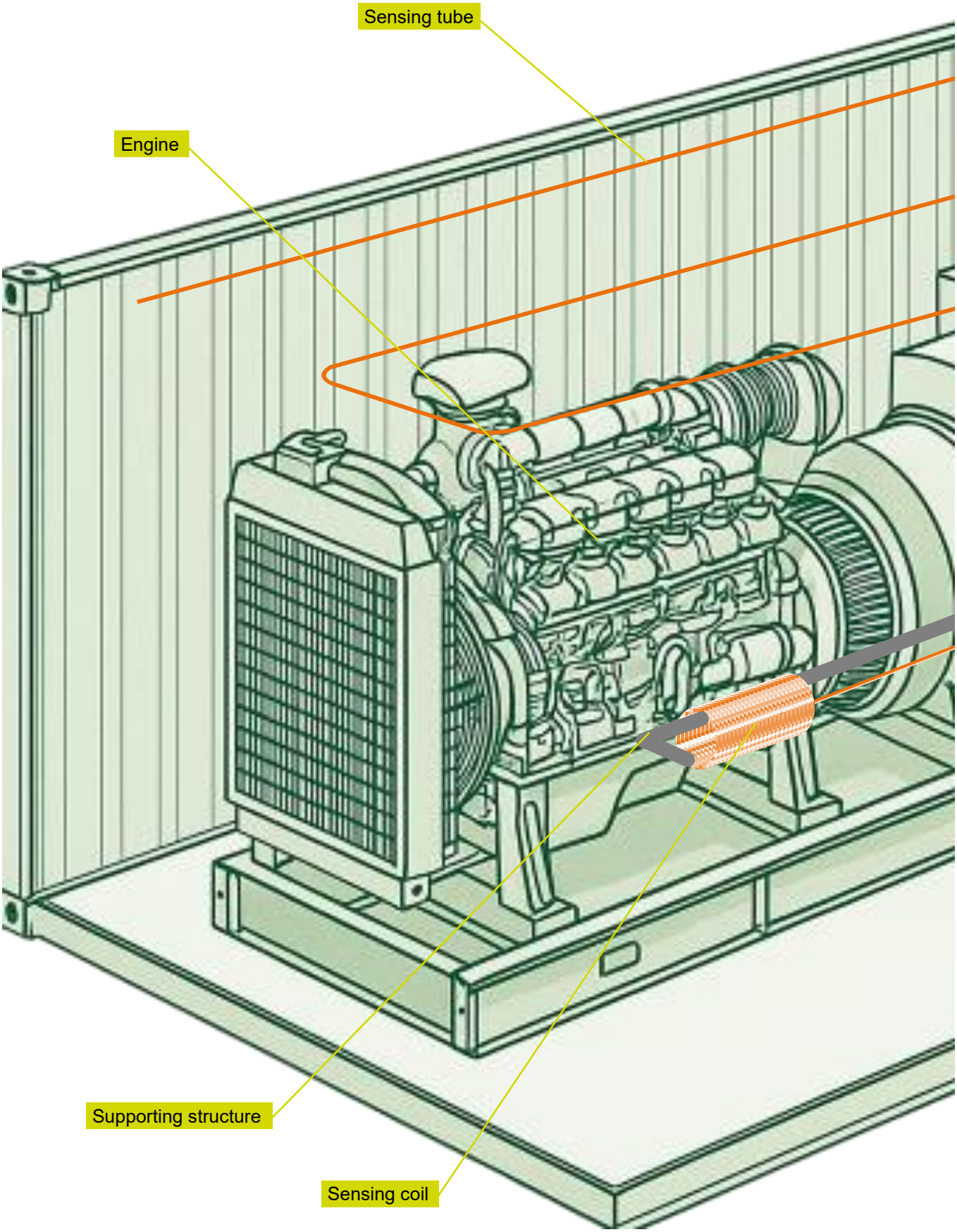
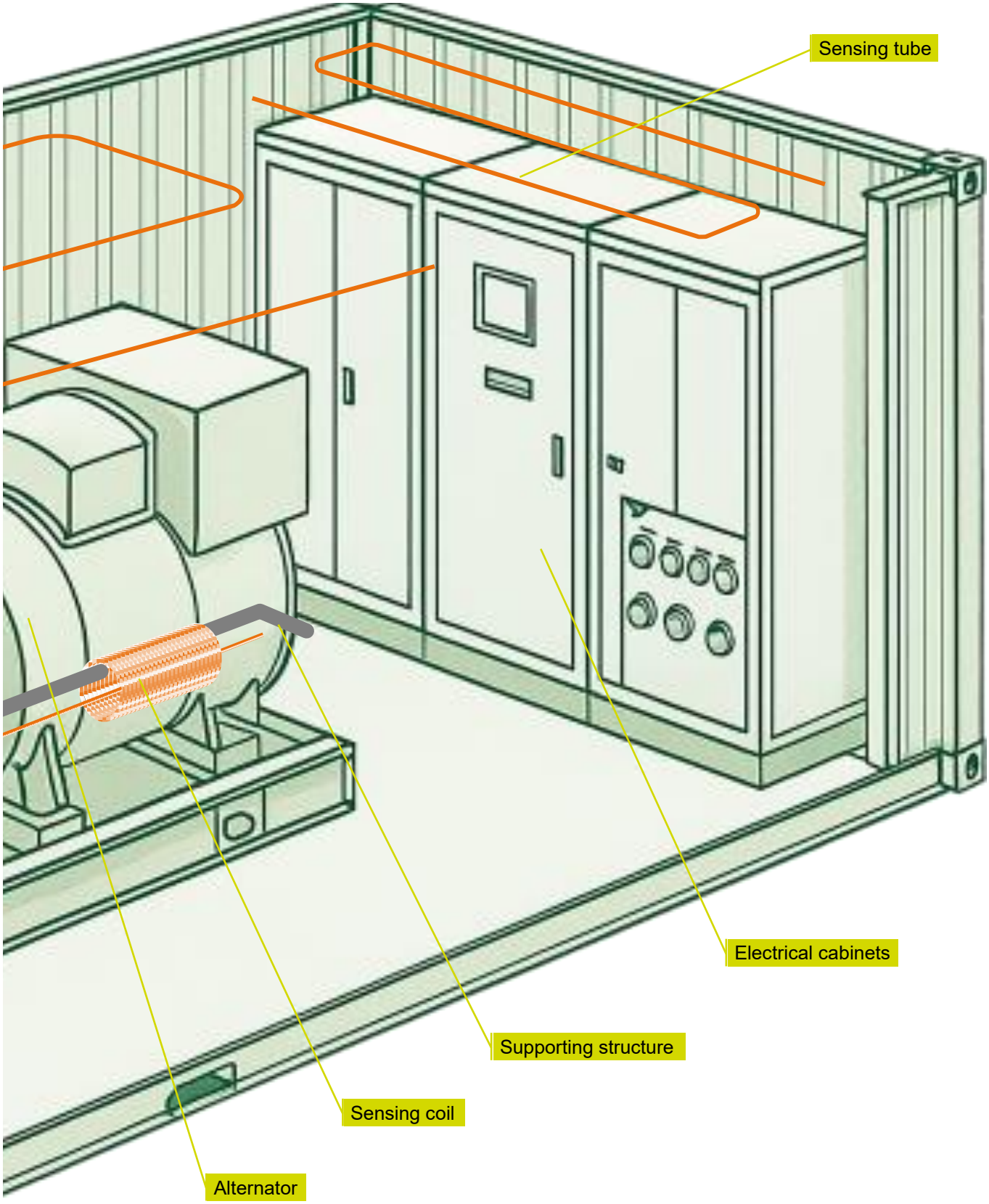


Figure 2 Mobile power generator in a container


Sensing tube
Electrical cabinets
Supporting structure
Sensing coil
Alternator

4.3 Application Scenarios

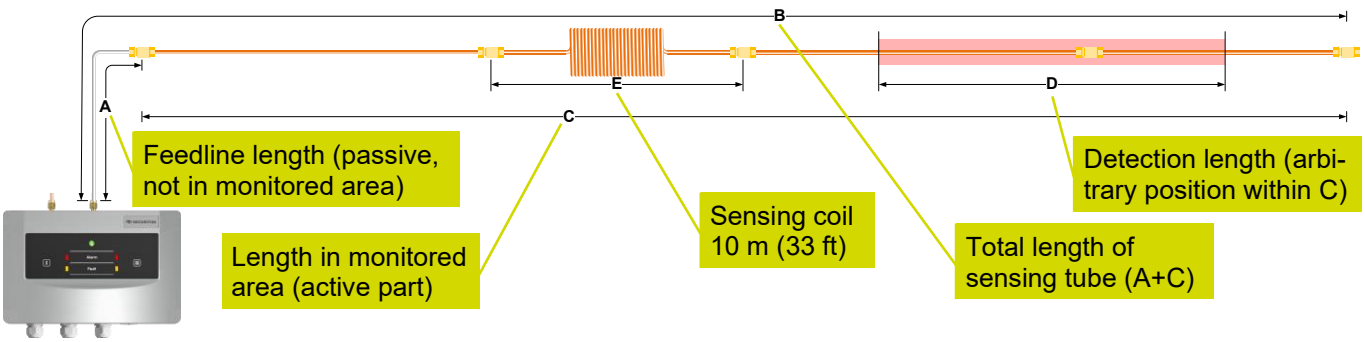
Pre-engineered containers for mobile power generators can be in the form of standard 20 ft or 40 ft type containers, or an in-built vehicle or trailer-mount self-contained unit. However, as the primary fire hazard are the diesel engine and the alternator, a SecuriHeat ADW system is used following the risk-informed, Performance-Based Design (PBD) principle. The essence of the design objective is to place SecuriHeat ADW tubing close to the diesel engine and the alternator itself where the highest risks are present. The tubing can also run underneath the roof of the container or truck to enhance the overall detection performance without increasing the cost of the installation and operation (see Figure 2).

Variable	Design recommendation
Spacing	Since this is a risk-based design where placement of the SecuriHeat ADW tubes is in close proximity of the engine and the alternator, the design generally meets the design code requirements of NFPA 72 [18] and EN 54-22 [1].
Placement	Sensing tubes should be mounted so that regular maintenance work on engine and alternator are not hampered. Consideration must be given to the fact that the minimal sensing tube length is 10 m (33 ft) and that at least 10% of the total sensing tube length (“B” in Figure 3 (a)) must be exposed to known potential fire ignition points to reliably detect a fire. This can be achieved either by using s sensing coil or a condensed arrangement of the sensing tube mounted on a supporting structure (see Figure 3 (b)). To allow for maintenance work on the engine and/or the alternator, it is recommended to position the sensing coils on the side rather than on top (see Figure 2). If a supporting structure is used, it should be swivel-mounted to allow access.
Orientation	Sensing tubes generally run in straight lines but are flexible enough to be bended to go around obstacles or other structural fittings when needed.
Additional notes	The ADW detector unit can be installed either in the same protected area or outside the protected area depending on operational needs. In general, one ADW 535 is sufficient to protect most mobile power generators. To avoid leaks in the sensing tube due to mechanical stress, use a length of flexible Polyamide tube as a feedline between the ADW unit and the sensing tube (see Figure 3 (c)) An external temperature sensor should be used to compensate temperature measurement drift if the detector unit is mounted outside the container (or outside the protected area).

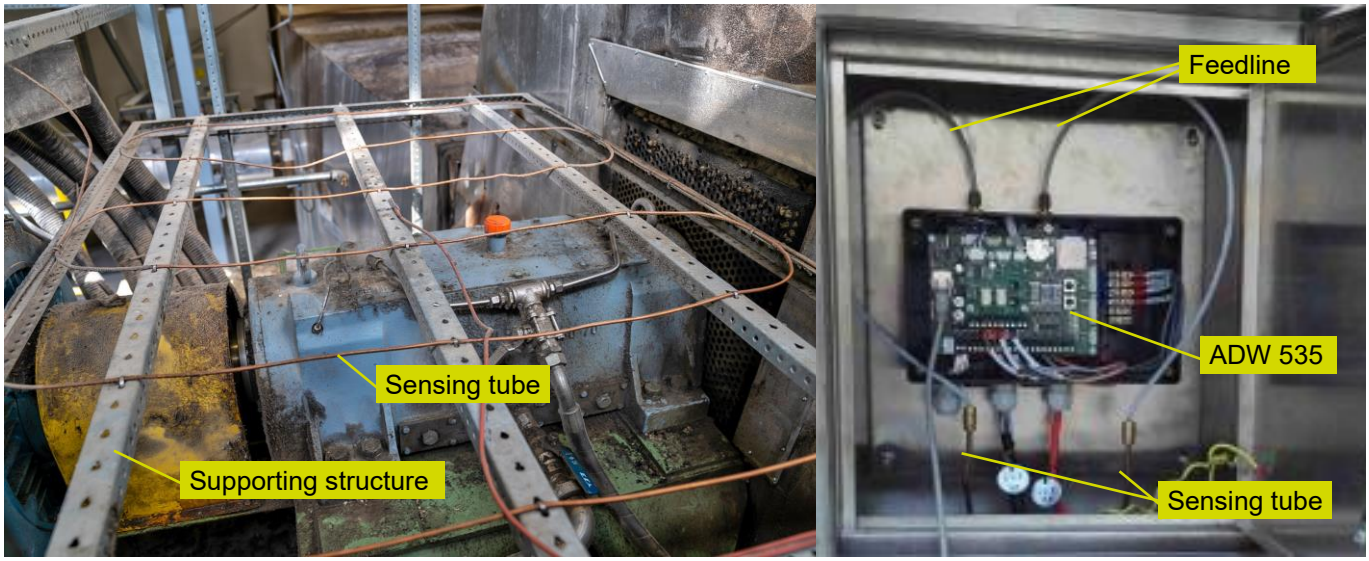
A further advantage of using SecuriHeat ADW 535 are the two levels of alert (‘Pre-signal’) and alarm signal (‘Alarm’). Alerts escalating to alarms from an overheating component or incipient fire provide the early warning needed to prevent the fire from spreading. Suitable training of staff in responding to the event at an early stage fire, combined with a reasonable level of alertness, should ensure that incidents are dealt with at an early stage. Staff can either confirm that there is no fire following inspection and reset the device following the initial alert, of tackle it suitably while raising the alarm level. Should the SecuriHeat ADW device continue to detect rising heat, it will progress to a full-blown alarm. The following table summarises the use of multilevel alarms.

Level	Signal	Typical use
1	Pre-signal	Verify and control (manually initiate the suppression)
2	Alarm	Initiate fire alarm; call fire brigade; initiate suppression

Table 4 ADW alert and alarm levels and suggested progressive response



(a) Typical SecuriHeat ADW sensing tube arrangement



(b) Sensing tube mounted on a supporting structure (c) Connection of feedline to tube and ADW

Figure 3 Illustration of SecuriHeat ADW design and applications

4.4 Features and benefits

Securiton AG as a whole is certified in accordance with ISO standards 9001, 14001 and 45001 and thus meets globally applicable standards with regard to quality management, environmental management, and occupational health and safety management systems. Below is a summary of the benefits of SecuriHeat ADW.

Features	Benefits
Copper or steel tubing	Resistant to harsh conditions to achieve best cost/benefit
Fully automatic system monitoring	Minimal maintenance
2-Level of Alarms	Pre-signal: Verify and control (manually initiate the suppression) Alarm: Initiate fire alarm; call fire brigade; initiate suppression

4.5 Minimal system access for ITM

Due to the advanced automatic sealing test and automatic self-test functions of SecuriHeat ADW 535, the detection system is largely maintenance free. However, local codes and standards may require a periodic function check or visual inspection.

4.6 Support with peace of mind

SecuriHeat ADW LTHD products are supported with range of software tools as followings:

Tool	Usage
Design	ADW HeatCalc allows the design and planning of heat detection systems at a very early stage.
Install and Service	EasyConfig for simple systems. The practical ADW Config software tool is used for more complex systems and application-specific adaptations.
Monitor and manage	ADW HeatCalc and ADW Config. Extensive analysis functions and setting options ensure safe, cost-effective operation of your system.

Applications and design support includes mainly:

- Partner accreditation program
- Application and field engineering support
- Worldwide reach through a network of partners as well as subsidiaries and investment companies, with branch offices or local employees around the world.

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