VESDA DESIGN IN CAR PARKS WITH IMPULSE VENTILATION FANS APPLICATION NOTE

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Preface

This Application Note details the guidelines for the design of VESDA systems in car parks deploying impulse ventilation fans (IVF). IVF operation in car parks has the potential to affect the operation and effectiveness of installed fire safety systems (i.e. sprinklers) and adversely impact tenability conditions that could endanger occupants in the event of a fire.

These guidelines do not follow prescriptive codes and standards. The VESDA design forms an alternative fire safety solution with the primary objective to enable automatic and timely shut down of IVF operation at the early stages of fire to eliminate impact on smoke movement and fire safety systems.

The VESDA design must be validated via in-situ hot smoke tests to confirm the operation of the complete system according to acceptance criteria agreed upon by all stakeholders during the Fire Engineering process.

Related Products

VESDA products.

Contents

1 Introduction

Impulse ventilation fan (IVF) systems are an alternative to traditional ducted systems for ventilating pollutants in enclosed car parks and other large enclosures (loading bays, service areas, etc.). Their benefits rely in installation flexibility, reduced installation cost and reduced energy consumption.

In car parks, IVF systems comprise a series of low profile ceiling mounted jet fans (Figure 1) strategically located throughout the space to direct pollutants towards pre-designated extract points and can be configured for the following ventilation schemes:

- Normal mode ventilation: Control and removal of vehicle exhaust fumes for day-to-day operation to maintain acceptable air quality. Normally, carbon monoxide (CO) monitoring is incorporated to enable demand control ventilation based on vehicle traffic.
- Smoke mode ventilation:
  - Smoke control: Provide smoke-free access to assist firefighting efforts or protect escape routes – this mode requires IVF systems in conjunction with exhaust ducted systems.
  - Smoke clearance: Provide a means of clearing smoke post fire event under fire brigade control.

Figure 1: Impulse Ventilation Fan in Car Park (cyclone induction type)

2 Fire Safety Challenges

From a fire safety perspective, IVF systems can adversely affect the operation/effectiveness of installed fire safety systems and have limitations as means of smoke control in car parks in the following ways:

- During the initial escape period, IVF systems will mix the smoke and prevent the formation of a clear smoke layer resulting in reduced visibility and tenability which might cause panic and disorientation.
- Affect sprinkler operation (where installed) both in terms of activation time and spray pattern.
- Fan the fire aiding its development.
- Activate the wrong fire sprinkler heads.
- Promote fire spread to adjacent cars.
- Spread smoke in other unaffected areas of the car park downstream and upstream the fire.
- Where IVF systems are driven by CO monitoring, generation of CO during a fire will cause the system to increase airflow further impacting smoke movement and sprinkler operation.

In addition, car park layouts present further fire safety challenges since there is no physical separation between smoke and occupants' escape routes and no smoke reservoirs to contain the smoke.

If not adequately addressed, IVF systems in car parks may increase the risk to occupants and fire fighters, impact on the effectiveness of firefighting activities (search, rescue) and increase property damage.

To meet the fire safety objectives in car parks with IVF systems, the appropriate fire safety strategy would be to provide an alarm signal for automatic shutdown of the IVF system at the early stages of fire.

VESDA systems having been successfully applied in car parks for general fire detection and having been integrated with smoke management systems in numerous applications are suitable to provide this alarm signal for timely IVF shutdown.

3 VESDA System Design

Each car park design and IVF system layout is different which may result in different airflow patterns; specific analysis for each cark park design must be undertaken. The items below provide generic guidelines on the setup of the VESDA detector and pipe network for integration with IVF systems:

Detector Settings:

- Set Fire 1 alarm signal for jet fan shut to 0.2%/m (0.061%/ft) – this alarm level might require adjustment following the results of in-situ hot smoke tests during commissioning.
- Fire 1 signal shuts down all jet fans in the car park to minimise smoke spread – exception to this might be jet fan(s) pushing air outside the car park.
- Fire 1 alarm signal can be set to latching or non-latching in relation to building controls and site fire safety strategy, for example:
  - Fire 1 latching: IVF system resumes operation manually by fire brigade upon arrival
  - Fire 1 non-latching: IVF system resumes operation automatically once smoke has cleared
- Fire 1 signal should not activate occupant warning system or fire brigade notification

Pipe Network Layout:

Xtralis does not recommend sampling within the jet fan enclosure since this might present a risk of delaying or failing to detect a fire downstream if no other jet fan is present.

- For jet fan monitoring, position sampling holes 8m (26ft) downstream from the jet fan at a 4m (13ft) by 3m (10ft) spacing grid as depicted in Figure 2. Typically at the location of the sampling holes, the air velocity at ceiling level is approximately 2m/second (394 fpm).
- A VESDA detector can protect more than one jet fan provided max smoke transport time is less than 30seconds.
- Sampling holes can be assigned to protect other areas of the car park conforming to local codes and standards.

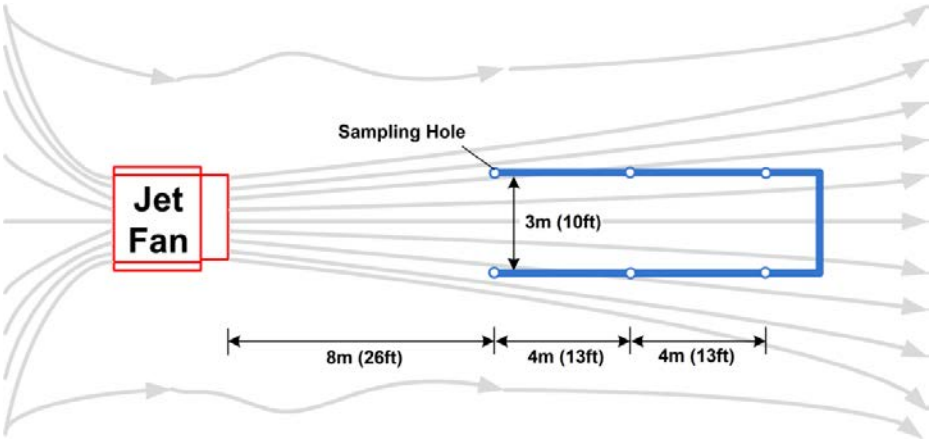

Figure 2: VESDA Pipe Network Layout for IVF protection

Note!

For complicated car park designs and IVF layouts it is advised an analysis is undertaken using computational fluid dynamic (CFD) modelling to assess smoke movement to help identify optimum location of sampling holes.

4 VESDA Commissioning

The VESDA design forms an alternative fire safety solution therefore the Fire 1 alarm threshold intended for IVF automatic shutdown must be validated during the commissioning phase of the safety systems under various fire scenarios applicable to the car park's fire hazards. Normally commissioning would be in form of hot smoke tests.

Smoke testing during commissioning should demonstrate that the time taken for automatic IVF shutdown via the VESDA Fire 1 ensures that:

- Smoke layer is re-established and tenability is maintained for the period of time occupants take to evacuate the car park or tenability conditions are at least equivalent to those which would have occurred if the car park was provided with a ventilation system complying with the Deemed-to-Satisfy provisions of local codes and standards.
- Difference in sprinkler activation times between scenarios when jet fans are running at full design speed and when jet fans are off is negligible.

Typically this analysis will need to be undertaken for two scenarios (i) fire located within the immediate airflow downstream the jet fan and (ii) fire located outside the jet fan immediate airflow.

Note!

The objective of hot smoke tests is to verify that VESDA and IVF systems operate and perform in accordance with the design specification and performance criteria as agreed by fire engineers and Principal Certifying Authorities (i.e. fire brigade) during the Fire Engineering process.

5 References

- NSW Fire & Rescue Safety Guideline, (2014) Guideline for Impulse Fans in Car Parks, v01, Oct 2014.
- Hot Smoke Testing of Car Park Impulse Fan Ventilation Systems, Fire Australia 2013, CSIRO.

6 Further Support

Contact an Xtralis office or distributor for further information.

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