VESDA-E VEU

Engineering Specification

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Contents

1 Scope

This document provides specification details of the VESDA-E VEU Air sampling Smoke Detection (ASD) products to assist in their installation and commissioning.

2 System Information

2.1 General

A Very Early Warning Smoke Detection System similar to the VESDA-E VEU System shall be installed throughout the areas nominated on the drawings.

The system shall consist of highly sensitive short wavelength LASER-based Smoke Detectors with aspirators connected to networks of sampling pipes.

When required, an optional Display unit shall be provided to monitor each detector.

2.2 Approvals

The Very Early Warning Smoke Detection System must be of a type submitted to, tested, approved, and/or listed by a Nationally Recognized Testing Laboratory (NRTL) as follows:

- UL (Underwriters Laboratories Inc), USA
- ULC (Underwriters Laboratories Canada), Canada

When used within the EU, the system shall be declared to the Construction Products Regulation (EU) 305/2011 by a notified body such as VdS when tested to the EN54-20 standard.

2.3 Codes, Standards or Regulations

The VEU smoke detector shall be installed to comply with one or more of the following codes or standards:

1. AS 1670.1-2004, AS1603.8 – 1996, ASNZS 3000
2. Fire Industry Association (FIA), Code of Practice for Design, Installation, Commissioning & Maintenance of Aspirating Smoke Detector (ASD) Systems
3. NFPA Standards, US
4. NEC Standards, US
5. NZS 4512 : 2003
6. Local codes and standards

2.4 Quality Assurance

2.4.1 Manufacturer

The manufacturer shall have a minimum of 35 years production experience in the design and manufacture of high sensitivity air sampling smoke detection systems.

The manufacturer shall be certified as meeting ISO 9001:2008 for manufacturing.

2.4.2 Equipment Supplier

The equipment supplier shall be trained by the manufacturer to calculate/design, install, test and maintain the air sampling system and shall be able to produce a certificate stating such on request.

2.5 Documentation

The following documentation shall be supplied.

1. Product data and site drawings shall be submitted and shall include pipe layout, operational calculations and performance criteria. Tools such as Xtralis ASPIRE-E may be used to generate this material.
2. A copy of the manufacturer's installation, operation and maintenance manuals shall be supplied upon completion of the installation.
3. System commissioning data shall be supplied (in a format recommended by the manufacturer and per the instructions provided by the manufacturer) within 30 days of completion of the installation.

3 System Description

3.1 System Features

The system shall:

1. consist of a highly sensitive, short wavelength LASER-based, particle imaging and light scattering smoke detector, aspirator, and filter.
2. be modular, with each detector having display with indicator LEDs and a reset control button and optionally with a LCD Display showing detector status including fault categories and smoke level.
3. consist of an air sampling pipe network to transport air to the detection system, supported by calculations from a computer-based design modelling tool.
4. support optional equipment which may include intelligent remote displays and/or a high level interface with the building fire alarm system, or a dedicated graphics package such as Xtralis VSM.
5. be tested and approved to cover up to 2,000m^2 (20,000 sq.ft).
6. be approved to provide Ultra Very Early Warning Smoke Detection (Ultra-VEWSD) and provide four output levels corresponding to Alert, Action, Fire 1 and Fire 2. These levels shall be programmable and able to be set at sensitivities ranging from 0.001-20% obs/m (0.0003–6% obs/ft) with a resolution of 0.0002% obs/m (0.00006%obs/ft).
7. report any fault on the detector by using configurable fault relay outputs, via a peer-to-peer network or by communications to a monitoring software tool running on a PC or hand-held device such as a tablet or smart phone.
8. be self-monitoring for filter contamination.
9. incorporate a flow sensor in each pipe and provide staged airflow faults against flow fault thresholds that may be determined and set for each pipe individually.

4 Detection Technology

4.1 Light Source

The Detection Chamber shall employ a highly sensitive, short wavelength LASER light source.

4.2 Detection Method

The detection sensing method shall use both a two-dimensional image sensing array and at least 5 photodiodes spaced inside the chamber to detect various scattering angles.

The output data from the sensing method shall include particle size and mass scattering measures,

A particle counting method shall be employed for the purposes of:

1. Minimising the effect of large dust particles on the true smoke obscuration.
2. Monitoring contamination of the filter (dust & dirt etc.) to automatically notify when maintenance is required.

4.3 Analytics

The detector shall apply analytics algorithms based on output data from the sensing method to determine the nature of sampled airborne material. Such algorithms shall provide probabilities of sampled air containing dust, diesel particulate and smoke from overheating PVC wire.

4.4 Absolute Calibration

The detection chamber shall be factory calibrated and shall not use adaptive algorithms or drift compensation techniques to adjust the sensitivity or detector output from that established during commissioning.

5 Products

5.1 Manufacturer

Air Sampling Smoke Detection System: Acceptable Manufacturer.

Xtralis
4 North Drive
236 – 262 East Boundary Road
East Bentleigh VIC 3165
Australia
Telephone: +61 3 9936 7000
Fax: +61 3 9936 7200

5.2 Manufactured Units(s)

The VESDA-E VEU ASD system (Part Number VEU-XXX) can be supplied in the following configurations:

Part Number	Description
VEU-A00	Detector with LED indicators and reset switch
VEU-A10	Detector with LED indicators, reset switch and colour 3.5” LCD status display and touch screen.
VSP-960	Optional mounting bracket

5.3 Detector Features

The detector shall incorporate the following features.

1. The Detector, Filter, Aspirator and Relay Outputs shall be housed in a mounting box and shall be arranged in such a way that air is drawn from the fire risk area by an aspirator and a sample passed through a sample filter and detection chamber.
2. The Detector shall employ a short wavelength LASER light source and incorporate particle imaging and light scattering using a two-dimensional image sensing array and scatter pattern measurement using photodiodes.
3. The detector shall have an obscuration sensitivity range of 0.001-20% obs/m (0.0003–6% obs/ft) with a resolution of 0.0002%obs/m (0.00006%obs/ft).
4. The Detector shall have four independent field programmable smoke alarm thresholds across its sensitivity range with adjustable time delays for each threshold between 0-60 seconds.
5. The detector shall employ modular construction allowing field replacement of the filter, chamber and aspirator.
6. The detector shall allow future hardware expansion via stackable modules placed either on top or below the detector.
7. The Detector shall also incorporate facilities to transmit the following fault categories:
   - Detector
   - Air flow
   - Filter
   - System
   - Zone
   - Network
   - Power

- Chamber
- Module

8. The detector shall support the generation and transmission of urgent and minor faults. Minor faults shall be considered as servicing or maintenance signals. Urgent faults indicate the unit may not be able to detect smoke.
9. The detector shall have four in-line sample pipe inlets and must contain a flow sensor for each pipe inlet. Both Minor and Urgent flow faults can be reported.
10. The flow sensors in each pipe shall use ultrasonic flow sensing technology.
11. The filter shall be a disposable filter cartridge and shall be capable of filtering particles in excess of 20 microns from the air sample.
12. A second filter shall be ultrafine, removing more than 99% of contaminant particles of 0.3microns or larger, to provide a clean air barrier around the detector's optics to prevent contamination and increase service life.
13. The aspirator shall be a purpose-designed impeller air pump. It shall be capable of allowing for multiple sampling pipe runs up to 800m (branched) in total, (4 pipe runs per detector) with a transport time per applicable local codes.
14. The Assembly must contain relays for alarm and fault conditions. The relays shall be software programmable to the required functions. The relays must be rated at 2 Amp at 30 VDC. Remote relays shall be offered as an option and either configured to replicate those on the detector or programmed differently.
15. The detector shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each event shall be recorded. Each detector (zone) shall be capable of storing up to 20,000 events and does not require the presence of a display in order to do so.
16. The detector shall incorporate a galvanically isolated General Purpose Input (GPI) which activates in the event of an applied voltage of 5 to 50VDC and can be assigned by configuration to activate one of several functions (Reset, Disable, Reset/Disable, Stand-by, Mains OK, Day/Night).
17. The detector shall incorporate a monitored voltage-free input, to be used with isolated relay contacts, which is supervised using a 10k Ohm terminating resistor.
18. The detector shall have seven or more relays for remote indication of alarm, fault and other status. The assignment of relay functions shall be configurable.

5.4 Displays

When required, a detector display module may be located within the detector, a remote mounting box or a 19 inch remote rack.

Each Display shall provide the following features at a minimum:

1. Color LCD touch screen user interface
2. A bar graph display.
3. Four independent high intensity alarm indicators, Alert, Action, Fire 1 and Fire2, which correspond to the four alarm thresholds of the detector.
4. Alarm threshold indicators for Alert, Action and Fire 1.
5. Fault icons indicating faults for the categories: detector, chamber, filter, flow, aspirator, network, power and external module.
6. A remotely mounted Display may be optionally equipped with 7 or 12 configurable relays for signalling alarm and fault conditions.
7. A single mechanical button to support RESET and DISABLE commands
8. A touch screen interface to allow scrolling through status screens on the LCD.

5.5 Monitoring

The system shall have available software for the purpose of monitoring all devices connected to a system. Such software shall be provided to run on:

1. PC-based hardware
2. Android-based hardware
3. iOS-based hardware
4. A dedicated monitoring device built into a detector
5. A dedicated monitoring device mounted remotely from any detector

5.6 Configuration

5.6.1 Configuration Software Tools

The system shall have available software for the purpose of commissioning and configuring all parts of the system. Such software shall be provided to run on:

1. PC-based hardware
2. A dedicated monitoring device built into a detector
3. A dedicated monitoring device mounted remotely from any detector

5.7 Programming Device

Programming may be performed using a Windows® application running on a PC connected through a High Level Interfacing unit (PC-Link HLI) or by direct connection to a detector.

Each Programmer shall support the following features at a minimum:

1. Programming of any device on the VESDAnet system.
2. Viewing of the status of any device in the system.
3. Adjustment of the alarm thresholds of a nominated detector.
4. Setting of Day/Night, weekend and holiday sensitivity threshold settings.
5. Initiation of AutoLearn™, to automatically configure the detector’s alarm threshold settings to suit the current environment.
6. Multi-level password control.
7. Programmable latching or non-latching relay operation.
8. Programmable energized or de-energized relays.
9. Programmable high and low flow settings for airflow supervision.
10. Programmable aspirator speed control.
11. Programmable maintenance intervals.
12. Facilities for referencing with time dilution compensation.
13. Testing of relays assigned to a specific zone to aid commissioning.

5.8 Security

The following security measures shall be provided.

1. Connectivity via wireless access shall support WPA2 encryption with encryption key.
2. Access to a detector via Ethernet or WiFi shall be protected using a detector password specific to the detector and in addition to the WiFi encryption key.
3. All software connecting to a detector or peripheral shall support an authentication protocol to verify that it has been supplied by the manufacturer of the system.

5.9 Upgrading

There shall be provision for field upgrading the firmware in the system using a USB memory key connected directly to the detector, avoiding the need for a separate PC for this function.

5.10 Peer-to-peer detector communications network ports.

A peer-to-peer networking facility shall be provided for the purposes of reporting alarms, faults and monitoring status, history and for configuration of devices.

The peer-to-peer network shall:

1. Comprise a physical layer that shall:
   - comply with the ANSI/TIA/EIA-485-A-1998 electrical specifications
   - employ asynchronous serial data transfer
   - operate at a baud rate no less than 19.2 kBaud.
   - detect communications errors due to interference, open and short circuit
   - detect ground faults
2. Be able to support up to 200 devices (detectors, displays and programmers), of which 100 detectors can be supported.
3. Be capable of being configured in a fault tolerant loop for both short circuit, open circuit and ground fault. Any communication faults shall be reported unambiguously and shall be clearly attributable to an individual device or wire link in the fault messages.
4. Be configurable by PC based configuration tools that are available to configure and manage the network of detectors.

5.11 Secondary communications

Detectors shall provide inbuilt secondary communications for monitoring and configuration using the following physical media:

- USB
- 10/100 BaseT Ethernet
- WiFi (802.11b/g)

6 Application

6.1 Detection Alarm Levels

The system shall have four (4) independently programmable alarm thresholds. The four alarm levels may be used as follows:

5. Alarm Level 1 (Alert) - Activate a visual and audible alarm in the fire risk area.
6. Alarm Level 2 (Action) - Activate the electrical/electronic equipment shutdown relay and activate visual and audible alarms in the Security Office or other appropriate location.
7. Alarm Level 3 (Fire 1) - Initiate an alarm condition in the Fire Alarm Control Panel to call the Fire Brigade and activate all warning systems.
8. Alarm Level 4 (Fire 2) - Activate a suppression system and/or other suitable countermeasures.

Notes!

- The alarm level functions as listed are possible scenarios. Consideration should be given to the best utilization of these facilities for each application and the requirements of local authorities (e.g. Authorities Having Jurisdiction in the US).
- When used within the EU, alarm thresholds shall be configured to achieve the required sensitivity class (A, B or C).

6.2 Initial Detection Alarm Settings

Initial settings for the alarm levels shall be determined by the requirements of the fire zone. However, the setting for Fire 1 (Alarm Level 3) shall always appear as 100% on the bar graph scale. Default settings of the unit shall be:

1. Alarm Level 1 (Alert) 0.08% obs/m (0.025% obs/ft)
2. Alarm Level 2 (Action) 0.14% obs/m (0.0448% obs/ft)
3. Alarm Level 3 (Fire 1) 0.20% obs/m (0.0625% obs/ft)
4. Alarm Level 4 (Fire 2) 2.0% obs/m (0.625% obs/ft)
5. Initial (factory default) Alarm Delay Thresholds

6.3 Initial (factory default) settings for the alarm delay threshold shall be

1. Alarm Level 1 (Alert) 10 seconds
2. Alarm Level 2 (Action) 10 seconds
3. Alarm Level 3 (Fire 1) 10 seconds
4. Alarm Level 4 (Fire 2) 10 seconds
5. Air Flow Fault 5 seconds

6.4 Faults

The Detector Fault relay shall be connected to the appropriate alarm zone on the Fire Alarm Control Panel (FACP) in such a way that a Detector Fault would register a fault condition on the FACP. The Minor Fault and Isolate relays shall also be connected to the appropriate control system.

(Check local Codes, Standards or Regulations to determine whether compliance with this set up is required).

6.5 Power Supply and Batteries

The system shall be powered from a regulated supply of nominally 24V DC. The battery charger and battery shall comply with the relevant Codes, Standards or Regulations. Typically 24 hours standby battery backup is required followed by 30 minutes in an alarm condition.

Local Power Supply Standards that may apply:

1. UL 1481 Listed - provided the power supply and standby batteries have been appropriately sized / rated to accommodate the system's power requirements.
2. US Telecommunication Central Office Power Supply- the system shall operate on negative 48 VDC (provided continuously from the telephone central office power source) converted to 24VDC.
3. EN 54-4 approved power supply for use in Europe.
4. In accordance with AS 1670.1-2004 and NZS4512: 2003.

6.6 Sampling Pipe Design

6.6.1 Sampling Pipe

The sampling pipe shall comply with the following requirements.

1. The sampling pipe shall be smooth bore. Normally, pipe with an outside diameter (OD) of 25mm or 1.05" and internal diameter (ID) of 21mm or ¾" should be used.
2. The pipe material should be suitable for the environment in which it is installed, or should be the material as required by the specifying body (e.g. in the US, VESDA-E pipe material shall be UL 1887 Plenum rated CPVC).
3. All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector.
4. The pipe shall be identified as Air Sampling/Aspirating Smoke Detector Pipe (or similar wording) along its entire length at regular intervals not exceeding the manufacturer's recommendation or that of local codes and standards.
5. All piping should be supported at centers of the lesser of 1.5m (5ft) apart or that specified by local codes or standards.
6. The end of each trunk or branch pipe shall be fitted with an end-cap and made air-tight by using solvent cement. Use of a hole in the end-cap will be dependent on the network design (see ASPIRE-E calculations).

6.6.2 Sampling Holes

The sampling holes shall comply with the following requirements.

1. Sampling holes shall not be separated by more than the maximum distance allowed for conventional point detectors as specified in the local codes and standards. Intervals may vary according to calculations. For AS1670.1-2004 the maximum allowable distance is 10.2m. For FIA the maximum allowable distance is 10.6m. For NFPA the maximum allowable distance is 30ft.
2. Each sampling point port shall be identified in accordance with Codes or Standards.
3. Consideration shall be given to the manufacturer's recommendations and standards in relation to the number of sampling points and the distance of the sampling points from the ceiling or roof structure and forced ventilation systems.
4. Sample port size shall be as specified by ASPIRE-E calculations.

7 Installation

7.1 The Detection system

The contractor shall install the system in accordance with the manufacturer's System Design Manual.

7.2 Mounting

The detector shall be capable of vertical mounting with sample air inlet ports directed up toward the ceiling (normal mounting) or down towards the floor (inverted mounting).

The detector shall be capable of mounting directly to a wall using screw fasteners or by using a stainless steel mounting bracket such as the VSP-960.

Where a mounting bracket is used, it shall be marked or engraved with the correct locations of inlet port sample pipes and cutting guide and electrical conduit locations.

7.3 The Capillary Sampling Network

The capillary sampling network shall comply with the following requirements:

1. Where false ceilings are installed, the sampling pipe shall be installed above the ceiling, and Capillary Sampling Points shall be installed on the ceiling and connected by means of a capillary tube.
2. The typical internal diameter of the capillary tube shall be 5mm or 3/8”, the maximum length of the capillary tube shall be 8m (26 ft) unless the manufacturer in consultation with the engineer have specified otherwise.
3. The Capillary tube shall terminate at a Ceiling Sampling Point specifically designed and approved by the manufacturer. The performance characteristics of the Sampling Points shall be taken into account during the system design.

7.4 Air Sampling Pipe Network Calculations

Air Sampling Pipe Network Calculations shall be provided by Air Sampling Pipe Network modelling program such as ASPIRE-E. Pipe network calculations shall be supplied with the proposed pipe layout design to indicate the following performance criteria:

7.4.1 Transport Time

Wherever possible the transport time (i.e. the time taken by smoke sampled to reach the detector) for the least favourable sampling point shall be less than 60 seconds for open hole sampling and less than 90 seconds for capillary tubes. Longer transport times may be tolerated where long pipe runs are required and where local codes and standards permit.

Local codes and standards may also apply. For example:

- AS1670, Part 1 Australia 90 Seconds
- FIA Code of Practice UK 120 Seconds
- NFPA 72 The Americas 120 Seconds
- NFPA 76 The Americas 60 Second

When used within the EU the maximum transport times shall be in accordance with the limits approved under EN54-20.

7.4.2 Balance %

The balance is the ratio of lowest sample hole flow rate to the highest, expressed as a percentage. The sample point balance for the pipe shall not be less than 70% as indicated by ASPIRE-E.

Tools such as Xtralis ASPIRE-E calculate the balance for a protected area as part of the outputs for modelled pipe sampling network.

8 System Commissioning

8.1 Detector commissioning

The detector shall incorporate a push button to invoke self-learning modes to simplify commissioning including::

1. a learning mode that ensures the best selection of appropriate alarm thresholds during the commissioning process
2. a learning mode that determines the optimum flow fault thresholds based on environmentally induced flow changes during the commissioning process.

Additionally, there shall be provision for a PC software tool to configure all user modifiable parameters of the all system devices.

8.2 Commissioning Tests

The contractor shall allow for the manufacturer's representative to attend commissioning of the entire installation in the presence of the owner and/or its representative.

All necessary instrumentation, equipment, materials and labor shall be provided by the Contractor.

The Contractor shall record all tests and system configuration and a copy of these results shall be retained on site in the System Log Book.

8.3 System Checks

Visually check all pipes to ensure that all joints, fittings, bends, sampling points, etc., comply with the Specification.

Check the system to ensure the following features are operational and programmed in accordance with the specification.

1. Alarm threshold levels (for both day and night settings),
2. Time delays,
3. Pipes in use,
4. Detector address,
5. Display address,
6. Clock time and date,
7. Air flow fault thresholds,
8. Reset button operable,
9. Touch screen operable where installed,
10. Referencing
11. Units set to U.S./S.I. (for US only) or metric for other regions
12. Check to ensure that all ancillary warning devices operate as specified.
13. Check interconnection with Fire Alarm Control Panel to ensure correct operation.

8.4 Final Tests

The contractor shall:

1. Introduce smoke into the detector assembly to provide a basic Go / No-Go functional test.
2. Verify that transport time from farthest sampling port does not exceed the local code requirements.
3. Activate the appropriate Fire Alarm zones and advise all concerned that the system is fully operational. Fill out the logbook and commissioning report accordingly.

9 Maintenance

9.1 Sample Filter

The detector shall incorporate a replaceable cartridge-style filter to remove large contaminants from the sampled air.

The filter shall be accessible by opening the cover to the field wiring terminal area.

Once accessible, the filter shall be removable and replaceable by hand without the need of a tool.

The filter shall incorporate an electronic circuit which identifies it uniquely and maintains status information such as the percent of filter life remaining.

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