Gas Fire Extinguishing System

1 Introduction

This document describes the gas fire-extinguishing system of ESS.

2 System introduction

As the existing mainstream fire-extinguishing scheme, the gas fire-extinguishing system adopts a completely submerged fire-extinguishing method, that is, within a specified time (within 10s), spray a certain concentration of fire-extinguishing agent and make it uniformly fill the whole protection area. At this time, it can extinguish the fire occurring in any part of the area. The fire-fighting medium is NOVEC1230 or FM200, which will be designed and provided by professional fire-fighting companies according to different project locations.

3 System composition

The entire energy storage battery container is used as an independent protective area. The side wall of the container is made of flame-retardant materials, which can isolate the fire or thermal runaway area in a short time, reduce the impact of the danger, and suppress the spread of thermal runaway.

The system is mainly composed of detector, controller, alarm and automatic fire extinguishing system, as shown in the figure below.

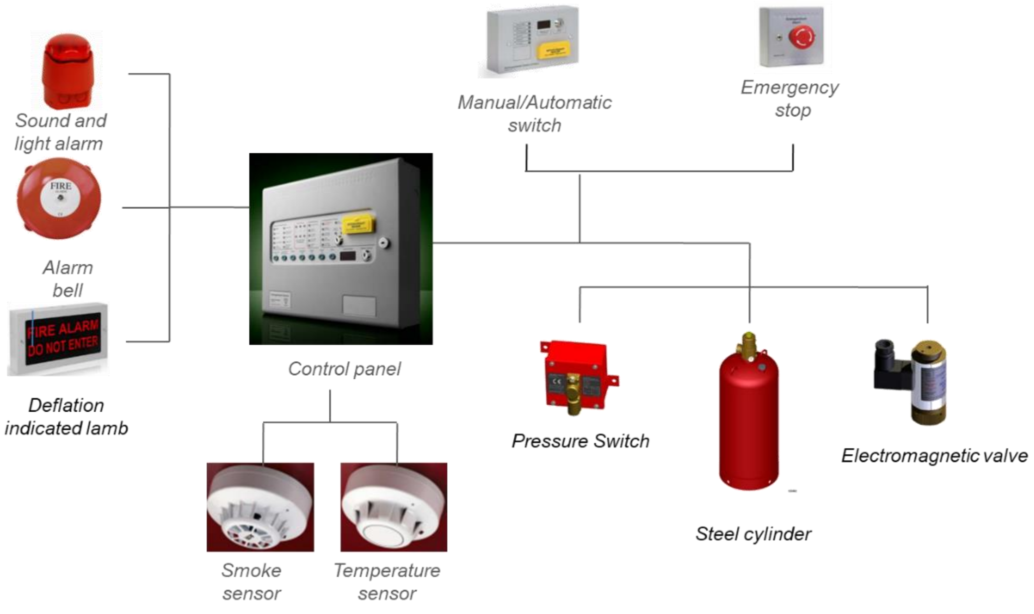

Fig. 1 Gas Fire Fighting Composition

In order to protect the mechanical strength of the protection zone, we usually install a pressure relief device. Our company uses a mechanical pressure relief port. The working principle is that the window is closed under normal circumstances and is attached by the bottom magnet. When the internal pressure exceeds the set value(1100Pa +/-100pa), the window will pop up. When the pressure is less than a certain range of the set value(1100Pa +/-100pa), the window It closes automatically under gravity.

Fig.2: Pressure Relief Device

4 Working principle of the system

The system has automatic and manual control modes. Each protection area is equipped with two independent detection circuits. The action flow chart is shown in the figure below.

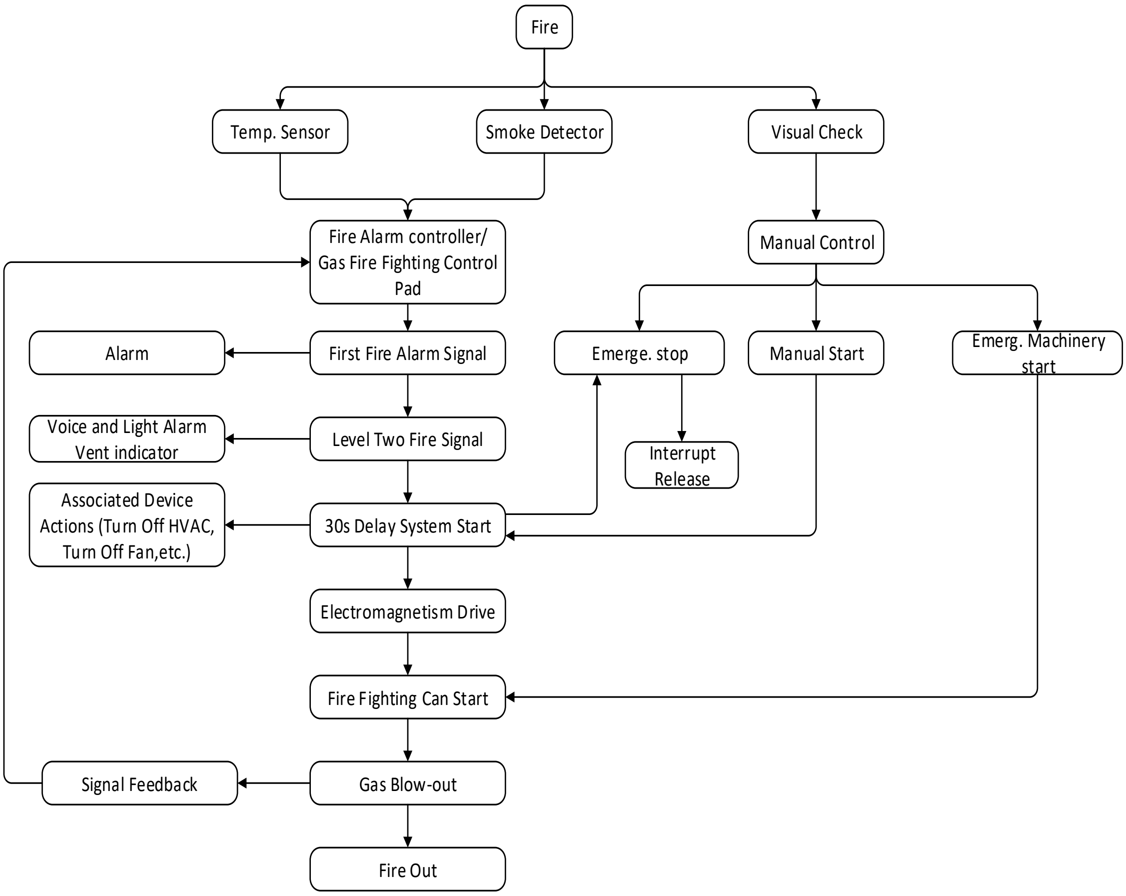

FIG. 3 Fire Fighting System Work Flow

4.1 Automatic Mode

If the protection area has smoke (or temp. raises), the protection area fire smoke detector (thermal sensor) will be activated and send the fire alarm signal to fire suppression controller. If one set of the thermal and smoke sensors is triggered, the controller will immediately switch to first class fire alarm status. Meanwhile the

electric-alarm will be activated and send out a signal. With the fire in protection area widespread and temp. going up (or smoke heavier), another set of fire suppression thermal sensor (or smoke detector) will be activated and send the controller another single fire alarm signal. The controller will immediately confirm the fire has already happened and switch to Lever two fire alarm status. Meanwhile the controller sends out comprehensive fire alarm, after pre-set time delay (leave enough time for nearby personal evacuation), controller will send out the signal to start fire suppression sequence and release fire suppression gas to protect the area by put out the fire. Controller will light up the gas release status light to avoid people getting closer.

4.2 Manual Mode

Fire Suppression System controller will only send the alarm signals but without corresponding reactions. When the personal on duty confirms the fire, he can press the Emergency start button to start the fire suppression sequence immediately.

Before the gas releasing signal send out, press emergency stop on the control board or manual stop can stop the fire suppression sequence if the personal found out it's a false alarm.

5 Fire Extinguishing Dose Calculation

According to ISO14520-1, the amount of extinguishant required to achieve the design concentration shall be calculated according to the following formula.

$$\mathrm{M} = \left(\frac{C}{100 - \mathrm{C}}\right)\frac{V}{S}$$

where

M is the total flooding quantity, in kilograms;

C is the design concentration in percent by volume;

V is the net volume of the hazard, in cubic metres (i.e. enclosed volume minus fixed structures impervious to extinguishant);

S is the specific volume, in cubic metres per kilogram: $S = k_1 + k_2T$

k_1, k_2 are constants specific to the extinguishant being used, supplied by the extinguishant manufacturer;

T is the minimum anticipated ambient temperature of the protected volume, in degrees Celsius.

The design quantity of the extinguishant shall be adjusted to compensate for ambient pressures that vary more than 11% (equivalent to approximately 1 000m of elevation change) from standard sea level pressure (1,013 bar absolute). The ambient pressure is affected by changes in altitude, pressurization or depressurization of the protected enclosure, and weather-related barometric pressure changes. Correction factors for gaseous agents are shown in Table 1. Correction factors for specific extinguishants will need to be calculated.

Table. 1 Correction Factors

Equivalent altitude m	Correction factor (for ideal gases)
–1 000 0 1 000	1,130 1,000 0,885
1 500 2 000 2 500	0,830 0,785 0,735
3 000 3 500 4 000 4 500	0,690 0,650 0,610 0,565

Take Novec 1230, 40-foot container as an example:

Design concentration: 5.85%

Altitude: 2000m

Temperature: 20℃

Dimensions of battery unit (W * H * D): 11978mm*2657mm*2280mm

The specific volume is

$$S=k_1+k_2T=0.0664+0.000274*20=0.07188$$

According to ISO 14520-5, for novec1230, k1=0.0664, k2=0.000274

Fire extinguishing dose calculation is

$$M_1 = \left(\frac{5.85}{100-5.85}\right)\frac{11.978*2.657*2.28}{0.07188} = 62.73kg$$

After altitude adjustment

$$\mathrm{M} = 0.785 * \mathrm{M}_1 = 49.24kg$$