

## 1. AUTOMATIC NITROGEN INERT GAS EXTINGUISHING SYSTEM

- 1.1. The Contractor shall design, supply, install, test and commission the complete 200 bar automatic Nitrogen inert gas extinguishing total flooding central bank system, fully complying with NFPA 2001 standard.
- 1.2. The proposed fire suppression system designed for this project shall be submitted together with principal's letter confirming that the design of the system is in compliance to the above standard and shall undertake responsibilities to their submitted design. The letter shall addressed directly to the tender bidder with specified tender's detail. The letter shall prepared under principal's original letter head and stated with person to contact together with their contact number. All copies of test certificate including components and system shall be submitted for review.
- 1.3. The type of inert gas selected shall have the following characteristics: -
  - a) Zero ozone depletion potential.
  - b) Zero global warming potential.
  - c) Suitable for use in human occupied rooms i.e. the gas at its designed fired concentration shall be safe to human in the fired room and below the NOAEL level.
  - d) The gas is widely used around the world.
  - e) Allowed for protecting "occupied area" as stated in SNAP list.

The nitrogen inert gas extinguishing system shall be designed to provide the quantity of gas required to achieve a design concentration stipulated in NFPA 2001. The nitrogen inert gas shall be discharged within the time allow in latest NFPA2001 to achieve the design concentrations. The gas-flooding requirement shall take into account to include the pressure relief damper. The specialist contractor shall submit pressure relief area calculation if required.

- 1.4. The nitrogen inert gas total flooding system shall be a centralized cylinder bank system developed locally. Nitrogen inert gas cylinder rooms shall be appropriately located within the building to house these banks. Upon detection of fire in the nitrogen inert gas protected rooms, the respective group shall be discharged to put out the fire with the design concentration. In each cylinder group there shall be minimum a pilot cylinder to activate all the cylinders in that group. A pressure switch shall be installed serving the protected rooms and send a signal to Extinguishing Control Panel (ECP) upon trigger. A pressure monitoring device shall be installed at each of the cylinders to trigger a signal to the Extinguishing Control Panel (ECP) when the gas pressure drop below a pre-set value. The Extinguishing Control Panel (ECP) shall send fire and fault signals to the Building Main Fire Alarm Panel appropriately.
- 1.5. All components of the Nitrogen inert gas extinguishing system shall be specifically listed or acceptable and must be interchangeable and supplied by single manufacturer.

- 1.6. The automatic Nitrogen inert gas extinguishing total flooding system shall be capable of being operated automatically and/or manually and shall comprise of but not limited to the following equipment: -
- a) Extinguishing Control Panels (ECP) with built-in battery charger, visible warning indicator, buzzer, auxiliary contacts and relays etc. It shall be located just outside the protected rooms.
  - b) Smoke detection system.
  - c) Audible warning system - alarm bells or/and sirens.
  - d) Visible warning system – twin flashing lights (Green and Red) and warning signs.
  - e) Standby battery.
  - f) Manual release (break glass) units.
  - g) Discharge nozzles and pipe work.
  - h) Inert gas cylinders (80Litres, 200 bar storage pressure), associated equipment mounting brackets and accessories.
  - i) Positive gas pressure gauge c./w gas leakage monitoring switches.
  - j) Clear warning signs.
  - k) Pilot cylinders.
  - l) Reset-able actuator valves.
- 1.7. The Contractor shall be responsible for the final system performance/hydraulic calculations c/w isometric diagrams based on the characteristics of the pipe work system and equipment actually installed. The contractor shall submit listed software calculation to verify the pipe work sizes for Engineer's acceptance prior to commencement of work. The same institution providing the listing for the system components shall list the hydraulic calculation software.
- 1.8. The Extinguishing Control Panels (ECP) and equipment installed out-door shall be weatherproof and suitable for outdoor installation, and shall be at least rated to IP55. The main contractor shall supply fused connection units next to the Extinguishing Control Panels (ECP) for the power supply to the control panels.
- 1.9. The Contractor shall liaise with the civil contractors who will provide self-closing doors, opening outwards of the gas protected rooms.
- 1.10. The contractor shall carry out a life test at site to demonstrate that the installation can perform as intended. The room where the life test is carried out shall be randomly selected by the engineer.

- 1.11. The contractor shall provide one free refill due to accidental discharge within the defects liability period.
- 1.12. Automatic Operation of System
  - a. The automatic Gas Extinguishing total flooding system shall operate automatically via a smoke detection system connected in double-knocked cross-zoned arrangement, in the protected room to minimize false discharges.
  - b. When one detector in the protected room has been activated, the following functions shall be executed simultaneously.
    - 1 The alarm bells within the protected area shall sound intermitted.
    - 2 The alarm buzzer at the Extinguishing Control Panels (ECP) shall be activated and sound continuously. The respective alarm zone indicator light shall be lighted up.
    - 3 The Red flashing lights(s) provided to the protected area shall illuminate and flash.
    - 4 Alarm signal shall be sent to the Building Main Fire Alarm Panel. The Extinguishing Control Panels (ECP) shall have a signal contact for the HVAC panel to shut down the ventilation fan/air conditioning unit of that particular protected room. The signal shall keep the motorized fire dampers (if any) of all gas protected rooms closed, served by the same common mechanical ventilation duct. The Contractor shall state clearly any pressure relief requirement during gas discharge. Electrical wiring for all shut-down signals shall be provided by others.
  - c. When another detector of the other zone within the same protected room is activated, the following functions shall be executed simultaneously.
    - 1 The alarm bells within the protected area shall sound continuous.
    - 2 The alarm buzzer at the Extinguishing Control Panels (ECP) shall be activated and sound continuously. The respective alarm zone indicator light shall be lighted up.
    - 3 The Extinguishing Control Panels (ECP) shall transmit a 24VDC to activate the solenoid valve of the pilot cylinder to release the Nitrogen inert gas from the required number of cylinders to the protected rooms after a 30-second delay. The discharge time of the Nitrogen gas from the nozzles shall not exceed 60 seconds to achieve the minimum design concentration as recommended by the Manufacturer's of the gas and NFPA 2001.

- 4 The LED on the Extinguishing Control Panel (ECP) shall light up to give a positive indication of Nitrogen inert gas discharged when the pressure switch is activated.

#### 1.13. Manual Operation

- a. The Contractor shall provide signal contacts for de-energizing the fans, air-conditioning units and activating the motorized fire dampers serving the Nitrogen inert gas protected rooms. The interface point between the automatic Nitrogen inert gas total flooding system and other trades shall be provided at the (ECP). The necessary wiring and relays between the Extinguishing Control Panel (ECP) and other trades panels shall be by others.
- b. An approved independent means for emergency manual operation shall be provided for the Nitrogen inert gas release for the protected room.
- c. The emergency manual releases shall cause the complete system to operate in its normal fashion. The emergency manual releases shall perform shutdown and alarm functions at the same time, as described in Clause 1.11 and Clause 1.12.

#### 1.14. Shut Down Signals For Air-conditioning Units, Fans, Automatic closures to openings.

- a. The Contractor shall provide signal contacts for de-energizing the fans, air-conditioning units and activating the motorized fire dampers serving the Nitrogen inert gas protected rooms. The interface point between the automatic Nitrogen inert gas total flooding system and other trades shall be provided at the Extinguishing Control Panel (ECP) . The necessary wiring and relays between the Extinguishing Control Panel (ECP) and other trades panels shall be by others.
- b. The ventilation fan can only run when the fire alarm signal at the Extinguishing Control Panel (ECP) is reset.
- c. Should any of the alarm signal lines be isolated, an indication light together with buzzer shall be registered at the Extinguishing Control Panel (ECP).

#### 1.15. Storage Containers

- a. The Nitrogen inert gas supply shall be stored in containers designed to hold Nitrogen inert gas at 200 bars and at 15°C. The containers shall be suitable for both automatic and manual control.
- b. Containers shall be super pressurized tested to test pressure 300 bars.
- c. The containers shall be designed, constructed, tested and marked in accordance with the latest U.S. Department of Transportation (DOT) specifications or Bureau Veritas or equivalent for seamless steel cylinders.

- d. Each cylinder shall have a permanent nameplate specifying the agent, tare and gross-weight in addition to the super-pressurization level. The date of charging shall also be indicated.
  - e. The cylinders shall be able to mount in vertical and also horizontal position and suitably supported in a purpose made rack, which provides for convenient individual servicing or weighing of contents. Cylinders shall be so installed as not to obstruct the swing of the inert gas room doors.
  - f. A reliable graduated pressure indicator, which accounts for variation of cylinder pressure with temperature, shall be provided for each container. Markings shall be provided to indicate when the pressure in the cylinder has dropped below the normal acceptable working pressure. The pressure indicators shall be installed for easy and accurate ready and shall not be obstructed. It shall be connected to ECP for 24 hours gas leakage monitoring.
  - g. Each cylinder shall be fitted with an automatic pressure release device, which provides relief at less than the test pressure defined in NFPA2001.
  - h. Means shall be provided to prevent Nitrogen inert gas discharging into another cylinder containers on the same manifold, which may have been previously discharged and to prevent loss if the Nitrogen inert gas is released when any of the cylinders are disconnected.
  - i. For systems requiring thirty-one (31) cylinders or more, the provision of dual 24V solenoid actuation devices shall be compulsory.
  - j. A manual lever actuator shall be provided at the inert gas storage cylinder.
  - k. The Nitrogen inert gas cylinders shall be painted signal according to international color code for pure inert gas.
- 1.16. Cylinder Discharge Valve
- Each Cylinder shall be fitted with a quick action discharge valve. The pilot cylinder shall be activated by an electromagnetic actuator which is reset-able.
- 1.17. Piping and Fitting
- a. The piping of the inert gas system shall be of ASTM A-106/A53 Grade B seamless galvanized pipes minimum schedule 40 downstream of the pressure reducer(orifice).
  - b. All pipe work shall conform to the requirements of NFPA 2001.
  - c. Welded manifolds shall be hot-dipped galvanized and shall be tested to a pressure of minimum 360 bars. The Manufacturer shall issue a pressure test certificate.

- d. Flexible piping, tubing or hose (including connections) used shall be of approved materials and the piping system shall have a minimum bursting pressure not less than that of the manifold pipe.
- e. Suitable provisions such as flexible hose shall be provided between the cylinder discharge valve and fixed pipe system to compensate for tolerance in container height and to allow easy removal and installation of container. Tools shall be supplied for the removal and dismantling of all special fittings.
- f. The piping system shall be securely supported with allowance made for agent thrust forces, thermal expansion and contraction. White arrows shall be painted on the pipe to indicate the direction of discharge from the cylinders.
- g. The piping system inside all the Nitrogen inert gas protected room shall be suitably earthed to the nearest equipment terminal.

1.18. Discharge Nozzles

- a. The discharge nozzles used shall comply with the requirements of NFPA 2001.
- b. The discharge nozzle shall be of corrosion resistant metal, and shall not be obstructed by other installations and/or equipment. The nozzles shall be installed in such a manner that the discharge of the Nitrogen inert gas shall not cause any damages to the installed equipment and fixtures, etc within the protected room.
- c. The nozzles shall be selected and located such that design concentration will be established in all parts of the Nitrogen inert gas protected area, and that the discharge will not unduly create dust clouds that might extend the fire, create an explosion, or otherwise adversely affect the contents of the protected area. Nozzles shall cover a height of 5m.
- d. Permanent markings shall be provided on the nozzles to facilitate the identification of the type, size and orifice diameter.

1.19. Smoke Detectors

- a. Smoke detectors shall be installed and tested in accordance with local requirement and the Manufacturer's recommendation.
- b. The smoke detectors shall also comply with local authority requirement.

1.20. Alarm Bells

Alarm bells complying with the local requirement and shall be provided within the Nitrogen inert gas protected area.

1.21. Siren (if any)

Siren shall be corrosion proof, 24V dc operated, high quality pattern conforming to the authority requirements.

1.22. Flashing (Green/Red) Light

A flashing light operating on 24 V dc shall be provided outside each entrance to the Nitrogen inert gas protected room. The flashing light shall be visible when operated within a lighted room.

1.23. Signage

Caution signs complying with the requirements of NFPA 2001 shall be provided at all entrances and within the area protected by Nitrogen inert gas extinguishing system to inform persons entering the protected area that an Nitrogen inert gas extinguishing system has been installed. The signs shall be adhered using good quality adhesives suitable for use in both indoor and outdoor conditions. All signs shall be subject to acceptance by the Engineer before fabrication.

1.24. Extinguishing Control Panel (ECP)

- a. The Extinguishing Control Panel (ECP) shall be located outside adjacent to the entrance of the Nitrogen inert gas protected rooms. The panel shall have local authority approval and SIRIM approval .
- b. The Extinguishing Control Panel (ECP) including the battery cabinet shall be wall mounted or recessed type and shall be of a dustproof construction. The Contractor shall liaise with the architect to provide the necessary recesses and access doors. Control panels installed outside the building shall be of a weatherproof construction, and provided with an awning to protect it from the elements, and shall be at least rated to IP55.
- c. Paints used shall be durable and color fast, compatible with use in external environments.
- d. The Extinguishing Control Panel (ECP) shall be fabricated from minimum 2mm thick electro-galvanized steel sheet, epoxy powder coated signal red in color. The cabinet shall be fitted with a lockable door. All alarm zone indicators and associated switches shall be visible behind the locked door without opening the door.
- e. The Manufacturer's name, together with any other appropriate means of identification of the alarm system, shall be clearly and permanently marked on the control panel.
- f. The Contractor shall co-ordinate with the respective civil contractors to ensure that the Extinguishing Control Panel (ECP) are installed such that they are not damaged as a result of the swing of the doors.

g. System and Components

- 1 All components of the control panel shall be compatible with the MAP.
- 2 The design of the panel shall be for maximum reliability with minimum and easy maintenance.
- 3 The Extinguishing Control Panel (ECP) shall control but not limited to, the operation of the solenoid valves, sirens, flashing lights, alarm bells. It shall monitor and display the status with LEDs but not limited to main "ON/OFF", charger "ON/FAILURE". It shall be provided with switches for but not limited to, "FAULT BUZZER ISOLATE" and "TEST LAMP" and "RESET".
- 4 A signal from the Extinguishing Control Panel (ECP) to MFAP shall be provided to Extinguishing Control Panel (ECP) that is activated during Nitrogen inert gas alarm. This signal shall then send to HVAC panel to initiate the ventilation / exhaust mode operation of the particular inert gas protected room.

The addressable signals from Extinguishing Control Panel (ECP) shall include the following:

- i. Gas discharged in gas-protected rooms.
- ii. Gas pressure drop to indicate gas leakage.

1.26. Indicator and Control Function

- a. All indicators shall be long-life LEDs.
- b. The control panel shall provide the control functions complying with the requirements of local authority and NFPA 2001.

1.27. Power Supply

- a. The nitrogen inert gas system shall operate on 24V dc supply. The supply shall be drawn from maintenance-free batteries, which are kept fully charged by a suitable automatic charger operating on mains supply. The supply shall be capable of operating the system under maximum normal load for 24 hours and then continue to operate the system for the full design discharge period.
- b. The capacity of the battery shall be such that in the event of mains failure or charging disconnected power, the battery shall be capable of maintaining the standing load condition for not less than 24 consecutive hours and, after the 24 hour period, shall have sufficient capacity to transmit a full alarm including all bells, sirens and illuminated warning signs for a period of 1 hour. The battery shall be housed in a well ventilated, dust and vermin proof and weatherproof enclosure and shall be at least rated to IP55.



- c. The Contractor shall provide power supply to Extinguishing Control Panel (ECP) through fuse connection units
  - d. Power supply indicators and controls shall be provided to include 'Mains On' (green light) and 'Battery Fail' (amber light). A voltmeter and ammeter shall be provided on the panel to measure the battery voltage and current.
- 1.28. Battery Charger
- a. The battery charger shall be provided at the Extinguishing Control Panel (ECP) of constant potential with current limiting and automatic boost charging features and must be capable of fully recharging the battery within 12 hours after a full discharge. Visual indicators for battery charging and charger fault shall be provided. All power transistors, rectifiers and associated components shall be integral parts of the charger unit, with adequately sized heat sinks for all heat-dissipating components.
  - b. The control panel shall be capable of operating continuously at 110% of the rated voltage in supervisory condition without damage, and operate successfully during alarm conditions at 110% or 85% of rated voltage.
  - c. Isolating switches shall be provided within the control panel for cutting off the mains and battery power supplies during maintenance and repair.
- 1.29. Electrical Works
- a. All electrical Works must comply with the local codes.
  - b. All wiring shall be minimum 1.5mm<sup>2</sup> 600/1000V grade copper conductors. All cables shall be installed enclosed in galvanized threaded metal conduits.
  - c. Wiring for gas discharge solenoid valves shall be fire rated.