

NIOEC-SP-70-11(2)							
DOCUMENT CODE						NO. OF PAGES: 36	
PLAN/PRJ/SUB	UNIT	PHASE	DISCIPLINE	DOCUMENT TYPE	SERIAL NO.	REV. NO.	DATE
NIOEC	000	EG	IN	SP	7011	A2	SEPTEMBER, 2017



NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY
NATIONAL IRANIAN OIL ENGINEERING
& CONSTRUCTION COMPANY

NIOEC SP

NIOEC SPECIFICATION FOR FIRE AND GAS DETECTION SYSTEM

SECOND EDITION

SEPTEMBER, 2017

THIS STANDARD IS THE PROPERTY OF NATIONAL IRANIAN OIL ENGINEERING & CONSTRUCTION COMPANY. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED TO THE OWNER. NEITHER WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF THE NATIONAL IRANIAN OIL ENGINEERING & CONSTRUCTION COMPANY.

IN THE NAME OF GOD**FOREWORD**

By their very nature, technical Specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such Specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international Standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant Specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the ongoing projects.

In response to the initiative of the Design and Engineering Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design and Engineering Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and complied.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design and Engineering Director of NIOEC for evaluation and approval.

REVISION INDEX

REV. PAGE	1	2	3	4	5	REV. PAGE	1	2	3	4	5	REV. PAGE	1	2	3	4	5	REV. PAGE	1	2	3	4	5
1						26		X				51						76					
2		X				27		X				52						77					
3		X				28						53						78					
4		X				29						54						79					
5						30						55						80					
6		X				31						56						81					
7		X				32						57						82					
8		X				33						58						83					
9						34						59						84					
10						35						60						85					
11						36						61						86					
12		X				37						62						87					
13						38						63						88					
14		X				39						64						89					
15		X				40						65						90					
16						41						66						91					
17						42						67						92					
18						43						68						93					
19						44						69						94					
20		X				45						70						95					
21		X				46						71						96					
22						47						72						97					
23		X				48						73						98					
24		X				49						74						99					
25		X				50						75						100					

NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

5					
4					
3					
2	SEPTEMBER, 2017	R. YAZDANI	G. R. MOHSENI	M.R. FARZAM	M. KARGARNAJAFI
1	MAY, 2009	INST. DISC.	M. KHATIB	M.R.FARZAM	M.A.A.SAJEDI
0	JULY, 2005	ALAM	M. ORDOOBADI	M.R.FARZAM	M.A.A.SAJEDI
REV.	DATE	PREPARED	CHECKED	APPROVED	AUTHORIZED

CONTENTS:	PAGE NO.
1. SCOPE	3
2. REFERENCES.....	3
3. UNITS	4
4. DEFINITIONS AND TERMINOLOGY	5
4.1. Fire and Gas Detectors	5
4.2. Control and Indicating Equipment	6
4.3. Fire and Gas Alarm Devices	6
4.4. Auxiliary Equipment	6
4.5. Accommodation Spaces	7
4.6. Plant Units	7
4.7. Service Spaces.....	7
5. ABBREVIATION	7
6. CERTIFICATION AND APPROVALS.....	7
7. ENVIRONMENTAL PROTECTION	7
8. GENERAL REQUIREMENTS FOR FIRE AND GAS DETECTION	8
9. ZONES.....	9
9.1. General Consideration.....	9
9.2. Recommendation for Size and Number of Zones	9
10. FIRE DETECTORS	9
10.1. General Requirements.....	9
10.2. Recommended Types and Design Considerations	10
10.3. Selection Guides of Fire Detectors.....	12
10.4. Installation	16
11. COMBUSTIBLE AND TOXIC GAS DETECTOR	18
11.1. Combustible Gas Detector	18
11.2. Toxic (H ₂ S) Gas Detectors	19
11.3. Types of Combustible and Toxic Gas Detectors	20
11.4. Selection of Apparatus.....	21
11.5. Installation of Combustible and Toxic Gas Detectors	21
12. MANUAL CALL POINT.....	22
13. CONTROL EQUIPMENT DESIGN CRITERIA	23
13.1. General.....	23
13.2. Functional Requirement.....	24
13.3. Construction Requirement.....	27
13.4. Electrical Requirement.....	27
13.5. Substation Fire Alarm Control Panel (SFACP).....	28
14. INSPECTIONS AND TESTING	29
14.1. General.....	29
14.2. Factory Acceptance Test (FAT).....	29
14.3. Test Completion	30
14.4. SAT (Site Acceptance Test).....	30
15. SHIPPING	30

16. SPARE PARTS	31
16.1. Construction, Pre-commissioning and Commissioning Spare Parts	31
16.2. Spare Parts for Two Years of Operation.....	31
16.3. Maintenance Tools.....	31
17. GUARANTEES.....	31

1. SCOPE

This specification defines NIOEC'S minimum requirements for the design, selection and installation of automatic fire and gas detection system components. The purpose of an automatic fire and gas detection system is to detect fire and gas at the earliest practicable moment and to give an alarm so that appropriate action can be taken.

Deviations from this specification will only be permitted on obtaining written approval from NIOEC.

Resolution on cases not explicitly stipulated in this Specification, or on cases where conflicts may arise among the requirements of the referenced IPS and the international standards, shall be made through written consent and approval of NIOEC.

2. REFERENCES

The following standards, codes, and specifications, to the extent specified hereinafter, shall constitute a part of this NIOEC Specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the Vendor /Contractor.

API (AMERICAN PETROLEUM INSTITUTE)

API RP 555	"Process Analyzer"
------------	--------------------

BSI (BRITISH STANDARDS INSTITUTION)

BS 5839-1	"Fire Detection and Fire Alarm Systems for Buildings- Part 1: Code of Practice for Design, Installation, Commissioning and Maintenance of Systems in Non-domestic Premises"
BS 5839-3	"Fire Detection and Fire Alarm Systems for Buildings- Part 3: Specification for Automatic Release Mechanisms of Certain Fire Protection Equipment"
BS EN 14604	"Smoke Alarm Devices"
BS EN 54-1	"Fire Detection and Fire alarm Systems- Part 1: Introduction"
BS EN 54-2	"Fire Detection and Fire Alarm Systems: Power Control and Indicating Equipment"
BS EN 54-3	"Fire Detection and Fire alarm Systems: Fire alarm devices-Sounders"
BS EN 54-4	"Fire Detection and Fire Alarm Systems: Power Supply Equipment"
BS EN 54-5	"Fire Detection and Fire Alarm Systems: Heat Detectors, Point Detectors"
BS EN 54-7	"Fire Detection and Fire Alarm Systems: Smoke Detectors-Point Detectors Using Scattered Light, Transmitted Light or Ionization"
BS EN 54-11	"Fire Detection and Fire alarm Systems: Manual Call Points"

IEEE (INSTITUTE OF ELECTRONICS AND ELECTRICAL ENGINEERS)

IEEE 979	"Guide For Substation Fire Protection"
----------	--

IPS (INTERNATIONAL PETROLEUM STANDARD)

IPS-G-IN-270	"General Standard for Instruments of Fire and Gas Detection Equipment"
IPS-E-SF-260	"Engineering Standard for Automatic Detectors and Fire/Gas alarm Systems"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO 7240-1	"Fire Detection and Alarm Systems- Part 1: General and Definitions"
------------	---

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

NFPA 72	"National Fire Protection Association"
NFPA 92	"Standard for Smoke-Control Systems"
NFPA 301	"Code for Safety to Life from Fire on Merchant Vessels"

NIOEC-SIP (NIOEC SHOP INSPECTION PROCEDURE)

NIOEC-SIP-70-01	"Shop Inspection Procedure for Instruments"
-----------------	---

NIOEC-SP (NIOEC SPECIFICATIONS)

NIOEC-SP-70-01	"Specification for Instrumentation"
NIOEC-SP-00-10	"Specification for Units"
NIOEC-SP-60-00	"Specification for General design Philosophy for Electrical System"
NIOEC-SP-90-52	"Specification for Packing and Packages"
NIOEC-SP-40-03	"NIOEC Specification for Spare Parts Requirement"

UL (UNDER-WRITER LABORATORIES)

UL 217	"Single and Multiple Station Smoke Alarms"
UL 268	"Standard for Smoke Detectors for Fire Alarm Systems"
UL 827	"Standard for Central-Station Alarm Services"

3. UNITS

International System of Units (SI) shall be used in accordance with NIOEC-SP-00-10, unless otherwise specified.

4. DEFINITIONS AND TERMINOLOGY

4.1. Fire and Gas Detectors

Fire and gas detectors are those parts of an automatic fire and gas detection system which continuously monitors suitable physical and/or chemical phenomena for detection of fires and gas in the area under surveillance. (Fig. 1 Item A).

4.1.1. Heat Detector

A detector which responds to an increase in temperature, or rate of temperature rise, or both.

4.1.2. Smoke Detector

A detector sensitive to particulate products of combustion and/or pyrolysis suspended in the atmosphere (aerosols).

4.1.3. Flame Detector

A detector which responds to the radiation emitted by the flames from a fire.

4.1.4. Gas Detector

A detector sensitive to combustible/toxic gases.

4.1.5. Static Detector

A detector which initiates an alarm when the magnitude of the measured phenomena exceed a certain value, for a sufficient time.

4.1.6. Differential Detector

A detector which initiates an alarm when the differences (normally small) in the magnitudes of the measured phenomenon at two or more places exceeds a certain value, for a sufficient time.

4.1.7. Rate of Rise Detector

A detector which initiates an alarm when the rate of change of the measured phenomenon with time exceeds a certain value for a sufficient time.

4.1.8. Point Detector

A detector which responds to the phenomenon detected in the vicinity of a fixed point sensor.

4.1.9. Multi-Point Detector

A detector which responds to the phenomenon detected in the vicinity of a number of fixed point sensors.

4.1.10. Line Detector

A detector which responds to the phenomenon detected in the vicinity of a continuous line. Typical examples are projected beam smoke detectors and heat sensitive cable.

4.1.11. Resettable Detector

A detector which after response may be restored from its alarm state to its normal state on cessation of the conditions which caused the response, without the renewal of any component. Various types are self-resetting detector, remotely resettable detector and locally resettable detector.

4.1.12. Non-Resettable Detector

A detector which after response requires the renewal of a component or components to restore to its normal state.

4.1.13. Detachable Detector

A detector which is so designed as to permit it to be easily removed from its normal operating position for maintenance and servicing purposes.

4.1.14. Addressable Detection Systems

Addressable detection systems specify space and zone identification, or both.

4.2. Control and Indicating Equipment

The power required by detectors shall be supplied through control and indicating equipment. This item is used to accept the fire and gas alarm signal of the connected detectors, to indicate these alarms audibly and visibly and to indicate the location of the danger (Fig. 1 Item B). If required, it should be able to pass on the fire alarm signal through fire alarm routing equipment (E) to the fire fighting organization or, through the control for automatic fire protection equipment (G), to an automatic CO₂ or other extinguishing equipment. It can be used to monitor the correct functioning of the system and give audible and visible warning of any faults e.g. short circuit, line breakage or fault in power supply.

4.3. Fire and Gas Alarm Devices

Equipment which is used to give a warning of fire or gas e.g. sounder or visual indicator (Fig. 1, Item C). Wherever "the siren" is mentioned in this section, this could mean a number of sirens operated in parallel when required for adequate coverage of extensive premises.

4.4. Auxiliary Equipment

In an automatic fire and gas detection system there are equipment and connection elements which may sometimes be used as part of the system as follows:

4.4.1. Manual Call Point

A device for manual initiation of an alarm (Fig. 1, Item D).

4.4.2. Fire Alarm Routing Equipment

Intermediate equipment which routes an alarm signal from (B) to a fire alarm receiving station (F) (Fig. 1, Item E).

4.4.3. Automatic Fire Protection Equipment

Control of firefighting equipment, e.g. extinguishing installation (Fig. 1, Item H).

4.4.4. Control for Automatic Fire Protection Equipment.

An automatic device used to actuate the fire fighting system (H) after receiving a signal from (B) (Fig. 1, Item G).

4.4.5. Event Logger

A suitable logger or recorder to record all necessary events occurred in an automatic fire and gas detection system. (Fig. 1, Item M).

4.4.6. Power Supply

The power for control panel (Fig1, item B) and all auxiliary equipment shall be supplied from this unit (Fig. 1, Item L).

4.5. Accommodation Spaces

Spaces used for public, corridors, lavatories, cabins, praying rooms, offices, cinema, game rooms and pantries.

Public spaces are those portions of the accommodation which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

4.6. Plant Units

The area in which the process plants are installed.

4.7. Service Spaces

Those are used for galleys, pantries containing cooking appliances, lockers, and store rooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

5. ABBREVIATION

CCR: Central Control Room

DCS: Distributed Control System

FGDS: Fire and Gas Detection Systems

LEL: Lower Explosion Limit

PLC: Programmable Logic Controller

ROR: Rate of Rise

UPS: Uninterruptible Power Supply

6. CERTIFICATION AND APPROVALS

The F&G equipment shall bear CE marking in accordance with EMC- Directive 89/336/EEC, and the conformity certificates shall be provided.

The vendor shall also submit certificates/records of type test approval of the system, based on recognized national or international standards.

7. ENVIRONMENTAL PROTECTION

All field equipment shall be suitable for the ambient temperature as specified in the project documents and the material and construction shall be resistant to saliferous dust, insect attacks, and

moisture and fungus growth. Sunshades shall also be provided for protection against sunlight wherever required.

Outdoor equipment (instruments, panels and enclosures) shall be watertight to IEC 60529, IP 65 as a minimum.

8. GENERAL REQUIREMENTS FOR FIRE AND GAS DETECTION

- 8.1.** The early detection of a developing fire and an early warning to operational and fire fighting personnel form an important aspect in basic concept of fire protection.
- 8.2.** Automatic detection is of the utmost importance when immediate action is required, i.e. where products are handled which may ignite spontaneously on leaking to atmosphere. Typical examples are; within the enclosed compartments of gas turbines, at the seal areas of floating roof tanks, in computer and control rooms, and material stores. For other application, reference is to be made to Appendix A.
- 8.3.** The fire and gas detection systems (FGDS) on an installation are provided to enable the detection of escaped hydrocarbon gas as well as the development of any fire at the earliest possible stage, so that protective measures can be taken before the situation gets out of control.
- 8.4.** The system consists of strategically positioned sensors connected to a central panel. The centralized alarm and control systems shall be installed in the nominated control center for the specific area of product movement, jetty control room, building entrances, etc. Slave displays shall be installed for other locations where the occurrence of a fire needs to be known, such as; the general control center, the fire station, the gate-house entrance to the plant or refinery.
- 8.5.** Slave displays shall be installed only in centers which are manned 24 hours a day.
- 8.6.** The display system shall include all alarm detection and fire protection systems for flammable gas, fire and smoke.
- 8.7.** Alarm siren(s) shall be installed which will sound automatically upon activation by push-buttons and fire detection systems. Sirens shall have a range of at least 1.5 km in still air.
- 8.8.** As a minimum, all gas detectors and those components of the detection system which are located outdoor and enclosed hazardous area should satisfy the requirements for Zone 2 area as specified in NIOEC-Sp-60-00.
- 8.9.** The detection system should also be fed from UPS system. The fire alarm system shall operate on power supply circuit of 230 volt A.C (UPS or emergency power supply), 1 ph, 50HZ.
- 8.10.** The FGDS shall be located in control room. At least two workstations for monitoring shall be installed at fire station.
- 8.11.** The electrical connections should be monitored; i.e. fault alarm should be given in case of open circuit, short circuit and earth fault. Removal of any detection device, alarm appliance, system module, or standby battery connection shall result in a trouble signal. A fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.
- 8.12.** The fire alarm signal circuits and its electrical wiring shall be under constant automatic electrical supervision at all times from the fire alarm control panel.
- 8.13.** It should be possible to test the alarm levels from the control unit by simple means, such as local miniature switch.

8.14. Where specified by Client, addressable fire detection system for non industrial buildings shall be applied.

8.15. Wiring inside buildings shall be installed in conduit.

9. ZONES

A zone is a subdivision of protected premises such that the occurrence of a fire within it will be indicated by a fire alarm system separately from an indication of fire in any other subdivision. A zone will usually consist of an area protected by several manual call points and/or detectors, and is separately indicated to assist in location of the fire, evacuation of the building and fire fighting.

9.1. General Consideration

9.1.1. When a signal of fire is given it shall be necessary that there should be no confusion about the zone from which it is received.

9.1.2. The floor area of a single zone shall not exceed 2000 m² unless otherwise specified.

9.1.3. In general the signals used in different zones in the same premises should be the same.

9.1.4. Each zone should be readily accessible from the point(s) where the indication of the location of fire is provided. In general, access to any zone should be by normal circulation routes.

9.2. Recommendation for Size and Number of Zones

9.2.1. The floor area of a single zone shall not exceed 2000 m², unless otherwise specified.

9.2.2. The search distance, i.e. the distance that has to be traveled by a searcher inside the zone in order to determine visually the position of the fire, shall not exceed 30 m.

9.2.3. If the total floor area is 300 m² or less, then it may be considered as a single zone even though there may be more than one storey.

9.2.4. If the total floor area is greater than 300 m², then all zones should be restricted to a single storey, except that:

a) If the total floor area of a fire compartment is 300 m² or less, and any communication with other fire compartments is only at the lowest level of the building, then the fire compartment may be considered as a single zone even though there may be more than one storey within it;

b) If detectors or call points are fitted in stairwells, lift wells and etc., extending beyond the one floor but within one fire compartment, then the volume of the well should be considered as one or more separate zone.

10. FIRE DETECTORS

10.1. General Requirements

10.1.1. Fire detectors should, except for fusible plugs, be of a re-settable type such that after activation they can be restored to normal surveillance without the renewal of any component

10.1.2. Fire detectors connected in loops should further have a visible indication to show that they have been operated. The indication should continue until the loop has been manually reset. If the loop-connected detector which has been operated can be identified from the central control room, there is no need for identification on the detector itself.