



نگهداشت و افزایش تولید میدان نفتی بینک
سطح الارض

احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک



شماره پیمان:

053 - 073 - 9184

FIRE & GAS DETECTION DESIGN CRITERIA

نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه
D06	0001	DC	IN	120	PEDCO	GCS	BK

شماره صفحه : 1 از 28

طرح نگهداشت و افزایش تولید 27 مخزن

FIRE & GAS DETECTION DESIGN CRITERIA

نگهداشت و افزایش تولید میدان نفتی بینک



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Status:


IDC: Inter-Discipline Check
IFC: Issued For Comment
IFA: Issued For Approval
AFD: Approved For Design
AFC: Approved For Construction
AFP: Approved For Purchase
AFQ: Approved For Quotation
IFI: Issued For Information
AB-R: As-Built for CLIENT Review
AB-A: As-Built -Approved

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	<p align="center">FIRE & GAS DETECTION DESIGN CRITERIA</p> <table border="1"> <tr> <td>نسخه</td> <td>سریال</td> <td>نوع مدرک</td> <td>رشته</td> <td>تسهیلات</td> <td>صادر کننده</td> <td>بسته کاری</td> <td>پروژه</td> </tr> <tr> <td>D06</td> <td>0001</td> <td>DC</td> <td>IN</td> <td>120</td> <td>PEDCO</td> <td>GCS</td> <td>BK</td> </tr> </table>								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	D06	0001	DC	IN	120	PEDCO
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه															
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REVISION RECORD SHEET


PAGE	D00	D01	D02	D03	D04	D05	D06
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65							

PAGE	D00	D01	D02	D03	D04	D05	D06
66							
67							
68							
69							
70							
71							
72							
73							
74							
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76							
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130							



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شماره پیمان: 053 - 073 - 9184	<table><tr><th colspan="8">FIRE & GAS DETECTION DESIGN CRITERIA</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D06</td><td>0001</td><td>DC</td><td>IN</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table>	FIRE & GAS DETECTION DESIGN CRITERIA								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	D06	0001	DC	IN	120	PEDCO	GCS	BK	شماره صفحه : 3 از 28
FIRE & GAS DETECTION DESIGN CRITERIA																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
D06	0001	DC	IN	120	PEDCO	GCS	BK																			

CONTENTS

1.0	INTRODUCTION	5
2.0	SCOPE	6
3.0	NORMATIVE REFERENCES	6
3.1	LOCAL CODES AND STANDARDS	6
3.2	INTERNATIONAL CODES AND STANDARDS	6
3.3	THE PROJECT DOCUMENTS	8
3.4	ENVIRONMENTAL DATA	8
3.5	ORDER OF PRECEDENCE	8
4.0	ABBREVIATION	8
5.0	F&G SYSTEMS	9
5.1	GENERAL	9
5.2	F&G SYSTEM REQUIREMENTS	10
5.3	F&G GRAPHIC DISPLAYS	11
5.4	F&G DISPLAY MATRIX	12
6.0	POWER SUPPLIES	13
7.0	DETECTION SYSTEM DESIGN PHILOSOPHY	13
7.1	GENERAL	13
7.2	INTERFACES OF THE F&G/FIRE ALARM PANEL WITH OTHER SYSTEMS/UNITS	14
7.3	OPERATOR WORKSTATION (OWS)	15
7.4	SELECTION OF DETECTORS	15
7.5	DETECTORS VOTING LOGIC	16
8.0	FIRE DETECTION SYSTEM	16
8.1	GENERAL	16
8.2	FIRE DETECTION DEVICES IN OPEN AREA	17
8.3	FIRE DETECTION DEVICES IN BUILDING	18
8.3.1	HEAT/SMOKE DETECTOR IN BUILDING	18
8.3.2	FIRE DETECTION DEVICES ON TRANSFORMERS	18
9.0	GAS DETECTION SYSTEM	19
9.1	GENERAL	19
9.2	FLAMMABLE GAS DETECTION DEVICES IN OPEN AREA	20
9.3	FLAMMABLE GAS DETECTION DEVICES FOR DIESEL GENERATOR(IF ANY)	20
9.4	FLAMMABLE GAS DETECTION DEVICES IN BUILDING	21
9.5	TOXIC GAS DETECTION IN OPEN AREA	22
9.6	TOXIC GAS DETECTION DEVICES IN BUILDING	23
9.7	HYDROGEN DETECTION IN BATTERY ROOM	24
10.0	MANUAL CALL POINTS	25
11.0	ALARMS & LIGHTS DEVICES	25
12.0	DETECTION LAYOUT	26
13.0	SPARE PARTS AND SPECIAL TOOLS	27
13.1	SPARE PARTS	27
13.2	SPECIAL TOOLS	27

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک																									
شماره پیمان: 053 - 073 – 9184	<table><tr><th colspan="8">FIRE & GAS DETECTION DESIGN CRITERIA</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D06</td><td>0001</td><td>DC</td><td>IN</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table>	FIRE & GAS DETECTION DESIGN CRITERIA								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	D06	0001	DC	IN	120	PEDCO	GCS	BK	شماره صفحه : 4 از 28
FIRE & GAS DETECTION DESIGN CRITERIA																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
D06	0001	DC	IN	120	PEDCO	GCS	BK																			

13.1	SPARE POLICY.....	27
14.0	TRANING	27
15.0	GUARANTEE & WARRANTY	28

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>																									
شماره پیمان: 053 - 073 – 9184	<table><tr><th colspan="8">FIRE & GAS DETECTION DESIGN CRITERIA</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>PEDCO</td><td>120</td><td>IN</td><td>DC</td><td>0001</td><td>D06</td></tr></table>	FIRE & GAS DETECTION DESIGN CRITERIA								پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	PEDCO	120	IN	DC	0001	D06	شماره صفحه : 5 از 28
FIRE & GAS DETECTION DESIGN CRITERIA																										
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه																			
BK	GCS	PEDCO	120	IN	DC	0001	D06																			

1.0 INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.


With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

As a part of the Project, a New Gas Compressor Station (adjacent to existing Binak GCS) shall be constructed to gather of 15 MMSCFD (approx.) associated gases and compress & transfer them to Siahmakan GIS.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – Surface Facilities; New Gas Compressor Station
EPD/EPC CONTRACTOR (GC):	Petro Iran Development Company (PEDCO)
EPC CONTRACTOR:	Joint Venture of : Hirgan Energy – Design & Inspection (D&I) Companies
VENDOR:	The firm or person who will fabricate the equipment or material.
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
THIRD PARTY INSPECTOR (TPI):	The firm appointed by EPD/EPC CONTRACTOR (GC) and approved by CLIENT (in writing) for the inspection of goods.
SHALL:	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL:	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

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شماره پیمان:	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 6 از 28
053 - 073 - 9184	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	D06

2.0 SCOPE

This document covers minimum necessary requirements for the design and selection, manufacture, inspection, testing and delivery of Fire and Gas devices related to Binak New Gas Compressor Station (adjacent to existing Binak GCS).

It shall be used in conjunction with data/requisition sheets for present document subject.



3.0 NORMATIVE REFERENCES

3.1 LOCAL CODES AND STANDARDS

- IPS-M-IN-220 Material and Equipment Standard For Control Panel& System Cabinets
- IPS-G-IN-270 General Standard For Instrumentation of Fire and Gas Detection Equipment
- IPS-E-GN-100 Engineering Standards For Units
- IPS-E-SF-100 Engineering Standards For Classification Of Fires And Fire Hazard Properties
- IPS-E-EL-110 Engineering standard For Hazardous Area
- IPS-E-SF-260 Engineering Standard For Automatic Detector and Fire/Gas Alarm System
- IPS-G-SF-310 General Standard For Gas Detection
- IPS-M-IN-260 Material and Equipment standard for Alarm and Protective System
- IPS-G-IN-260 Engineering and installation standard for Indicating Light, Alarm and Protective system



3.2 INTERNATIONAL CODES AND STANDARDS

- API 610 Centrifugal Pumps for Petroleum, Petrochemical And Natural Gas Industries, 11th Edition
- ISO 15156 Petroleum and Natural Gas Industries. Materials for use in H₂S Containing Environments in Oil and Gas Production
- API RP 505 Recommended practice for classification of locations for electrical installations at petroleum facilities classified as Class 1, Zone 0, Zone 1 and Zone 2
- API RP 551 Process measurement
- API 552 Transmission systems
- BS EN 60079-7 Specification for Electrical apparatus for explosive

	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 7 از 28	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

atmospheres. Type of protection 'e'

- BS 5445 Components of Automatic fire detection systems-all parts
- BS 5839 Fire detection and alarm systems for buildings-all parts
- BS 6667 Electromagnetic compatibility for industrial process measurement and control equipment-all parts
- BS 7671 Requirements for electrical installations. IET wiring regulations
- BS EN 60529 Specification for degrees of protection provided by enclosure.
- EN 54 Fire detection & alarm systems
- BS EN 60079-0 Explosive atmospheres. Equipment-General requirements
- BS EN 60079-1 explosive atmospheres. Equipment protection by flame proof enclosure 'd'
- BS EN 50020 Electrical apparatus for potentially explosive atmospheres. Intrinsic safety "i".
- BS EN 60079-25 Explosive atmospheres. Intrinsically safe electrical system.
- BS EN 50058 Electrical apparatus for the detection and measurement of combustible gases. Performance requirements for group II apparatus indicating up to 100% Lower Explosive Limit.
- BS EN 61000-6 Electro-magnetic compatibility (EMC), generic standards, immunity for residential, commercial and light- industrial environments.
- EN 55022 Limits and methods of measurement of radio disturbance Characteristics of information technology equipment
- IEC 60331 Fire resisting characteristics of electric cables
- IEC 60331-23 Test for electric cables under fire conditions-circuit integrity-procedures and requirements-electric data cables
- IEC 60801-3 Electromagnetic compatibility for industrial process measurement and control equipment. Radiated electromagnetic field requirements
- IEC 61131-3 Programmable logic controllers
- IEC 61508 Functional safety of electrical/ electronic/ programmable electronic safety related systems

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شماره پیمان:	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 8 از 28
053 - 073 – 9184	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	D06

- ISA 5.1 Instrumentation symbols and identification.
- ISA 5.4 Instrumentation loop diagrams.
- ISA 18.1 Annunciators-sequences and specification.
- NFPA 30 Flammable and combustible liquids code-storage
- NFPA 70 National Electrical Code
- NFPA 72 National Fire Alarm and Signalling Code

3.3 THE PROJECT DOCUMENTS

- BK-GNRAL-PEDCO-000-PR-DC-0001 Process Basis of Design
- BK-GNRAL-PEDCO-000-PR-DC-0001 Piping & Pipeline Material Specification
- BK-GNRAL-PEDCO-000-IN-SP-0009 Spec. for Fire & Gas Sensor and Devices
- BK-GNRAL-PEDCO-000-IN-SP-0009 Spec. for F&G System
- BK- GENRL-PEDCO-000-IN-SP-0012 Specification For F&G system
- BK- GENRL-PEDCO-000-SA-SP-0002 Spec. For Hazardous Area Classification
- BK- GCS-PEDCO-120-IN-BD-0001 Control/ESD/F&G Sys. Block Diagram Configuration.

3.4 ENVIRONMENTAL DATA

Refer to " Process Basis of Design; Doc. No.: BK-GNRAL-PEDCO-000-PR-DB-0001".

All fire & gas equipment (i.e. detectors, system, final elements) shall be certified for use in the specific environmental conditions.



One aspect which should be considered is the ambient conditions in the various areas under which the detectors will have to operate. This will involve evaluation of natural environmental conditions such as wind, temperature, solar radiation, salinity, humidity, as well as industrial conditions such as dust, oily atmosphere, vibration, etc.

3.5 ORDER OF PRECEDENCE

In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT.

4.0 ABBREVIATION

Industry standard abbreviations shall take their usual meaning. Outlined herein are the most common, which may be used in this and other project documents:

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>																									
شماره پیمان: 053 - 073 – 9184	<table><tr><th colspan="8">FIRE & GAS DETECTION DESIGN CRITERIA</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D06</td><td>0001</td><td>DC</td><td>IN</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table>	FIRE & GAS DETECTION DESIGN CRITERIA								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	D06	0001	DC	IN	120	PEDCO	GCS	BK	شماره صفحه : 9 از 28
FIRE & GAS DETECTION DESIGN CRITERIA																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
D06	0001	DC	IN	120	PEDCO	GCS	BK																			

DCS	Distributed Control System
ESD	Emergency Shutdown System
F&G	Fire and Gas
FAT	Factory Acceptance Test
FGS	Fire and Gas System
HD	Heat Detector
HVAC	Heat Ventilation and Air Condition
IR	Infrared
IR3	Triple Infrared
IS	Intrinsic Safety
LEL	Lower Explosion Limit
MAC	Manually Alarm Call point
MMI	Man Machine Interface (Operator Interface)
PA	Public Address
PA/GA	Public Address/General Alarm
PLC	Programmable Logic Controller

5.0 F&G SYSTEMS

5.1 GENERAL

F&G Systems are dedicated to:

- Detect presence of fire and/or gas leak to protect personnel, environment and field equipment.
- Perform the related logic to control firefighting equipment, deluge valves, HVAC shutdown.
- Control and monitor the fire water pumps. (if any)

In case of F&G detection in process areas the F&G functions initiate ESD functions.

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>							
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 10 از 28
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	
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Initiation of Manual call Point (MP) trigger alarms without automatic action.

Fire Fighting Control Panel (FFCP) related to the CO2 package should be linked to F&G system to receive release commands during emergency cases. Package and lighting status will be sent to F&G system through this panel (for more information of CO2 package, refer to doc." Specification For Total Flooding System", No." BK-GNRAL-PEDCO-000-SA-SP-0005).

5.2 F&G SYSTEM REQUIREMENTS


The F&G system shall interface with the ESD and Distributed Control System and shall encompass both PLANT areas and PLANT buildings, and shall provide for sequence of Events Recording (SOER) in conjunction with the DCS. The Fire & Gas system shall continuously monitor the PLANT for hazardous conditions such as the presence of flammable and toxic gases, and detect fires via dedicated sensors wired to the inputs of the Programmable Logic Controllers. The PLCs shall then generate actions, as determined by the pre-programmed logic.

Information gathered by the F&G system shall be transferred to the DCS system for display, monitoring, and control. Additional 3rd party Fire Alarm (FA) systems (if any), which are located within the non-process buildings, shall interface directly to the F&G system for status display and monitoring only.

A connection between the DCS and the F&G system shall be provided in ITR.

The VENDOR shall be responsible for provision of the following items of equipment in each system, as a minimum, in accordance with the criteria defined within this specification;

- All system hardware, including all I/O modules, processor units, power supplies, system racks and system cables, as defined by this specification.
- Engineering Workstations.
- All required DC voltage power supplies for the system cabinets, IS isolators (where applicable) and field I/O.
- System cabinets to house the required hardware.
- Marshalling cabinets, including IS isolators (where applicable), terminals, power supplies, ferrules, cabinet wiring, etc.
- All interconnection cables between the Marshalling cabinets and system cabinets.
- All system software, including all configurations and programmed application logic, specially written programs to enable the system to function and interface to other systems as specified.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک								
شماره پیمان:	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 11 از 28	
053 - 073 – 9184	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001		D06

F&G systems will be interconnected to the DCS by redundant Modbus TCP/IP communications. On failure of one cable, the systems shall fall back to the remaining cable. On failure of all communication links between the two systems, the F&G systems shall continue to provide all safeguarding functions. VENDOR shall configure the systems to meet this requirement identifying operating procedures required to be put in place in accordance with the TUV guidelines.

5.3 F&G GRAPHIC DISPLAYS

The graphic displays shall show the entire status of the F&G system on common work station dedicated to ESD/F&G. The graphics shall also be viewed via the DCS operator workstations and the status shown shall include normal, alarm, fault, and inhibit conditions for all field devices.

Additionally, flammable gas detector LEL and toxic gas detector (if any) ppm levels shall be displayed at all times. Detector types shall be indicated by means of colored indications that shall be developed throughout the course of the detailed design phase of the project.

An overview graphic shall also be provided; this will consist of a simplified geographical layout of the plant areas that are to be monitored. Common indications for fire, flammable gas, toxic gas, MAC, and detector fault/inhibit shall be provided in each of the PLANT areas shown on this graphic.

- F&G detector layout graphics,
 - ✓ These shall include the status of individual sensors in the area, or the zone status, together with the status of deluges, and extinguisher system (total flooding if any) and fire water (fire pumps) systems. These displays shall include wind speed and direction for open areas of the plant.
- F&G overview displays
 - ✓ These shall be of matrix type, or arranged geographically, and shall show the F&G status for plant areas, or for the whole plant.
- Text displays such as F&G alarm summaries

Generally OCD shall have the capability of displaying any data from all parts of the plant regarding to F&G system.

The F&G system VENDOR shall assist the DCS VENDOR as required for the production of the F&G graphics.

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>							
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 12 از 28
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	
								D06

5.4 F&G DISPLAY MATRIX

This panel shall display the status of the F&G detection and protection systems. The F&G display matrix shall be driven by hardwired outputs from the I/O modules, and shall also allow manual remote activation of the Deluge Systems. These shall be hardwired to the inputs of the PLC.

The F&G Matrix panel will be mounted in the Control Room.

It should also display common indications for fault and alarm conditions within the process areas, including, but not limited to:

- Manual Call-point Activated
- Fire
- Flammable Gas
- Toxic Gas (if any)
- Fault/Inhibited Device

Detector types shall be indicated by means of colored LEDs. Color codes for the following indications shall be:

Toxic gas (if any)	Blue
Flammable gas	Yellow
Fire	Red
System fault	Red
Other alarms	Red

Flammable gas visual alarms should distinguish between High (H) and High High (HH) values by assigning one LED to H and one LED to HH level. Plant common alarms shall be grouped in the top left-hand corner to facilitate quick appraisal by operating personnel. Each alarm shall be presented by means of a colored lamp and the corresponding text as appropriate.

The normal situation shall be indicated by extinguished LEDs and lamps on the panel. In the event of an alarm, the relevant LEDs and lamps shall start flashing. After acknowledgement the flashing shall stop and change into steady light, but be reactivated on the recurrence of any alarm condition. Return to the normal situation, after acknowledgement, shall extinguish the LEDs and lamps.

An audible alarm shall be provided on the panel, with an intermittent 2000 cycles/sec tone.

An alarm acknowledges pushbutton shall be provided to silence the audible alarm and stop the flashing visual alarm. Remote alarm silence acceptance shall also be provided from the DCS operator station.

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان:	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 13 از 28	
053 - 073 – 9184	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001		D06

6.0 POWER SUPPLIES

F&G system power shall meet NFPA 72. F&G system shall be powered from the 24 VDC uninterrupted power supply which is totally independent and provided by battery for a period of 24 hours back-up (24 hours back up for system normal operating without alarming devices and at the end of this time 5 minutes for activation of all alarming devices). Battery charging shall be automatic, with double battery chargers.

Power distribution shall be configured such that the power supply and distribution for all levels of distribution up to the consumers shall be redundant. During failure of one power supply, the safeguarding system shall not be affected.

External power supply shall be non-grounded power supply. The VENDOR is required to indicate that his system can be powered from electrical grounded power supply as an alternate solution.

The power supply input circuit shall have independent over current protection and transient protection.

The VENDOR shall indicate the maximum allowable mains voltage spikes (amplitude and duration) that the system can withstand without affecting operation.

The VENDOR shall indicate the procedures to be followed and the features of the system, which allow system recovery after power failure.



7.0 DETECTION SYSTEM DESIGN PHILOSOPHY

7.1 GENERAL

Fire and gas detection devices shall be installed throughout the plant to detect hazardous conditions resulting from gas leakage or fire and to initiate appropriate alarms and actions.

The purpose of the Fire and Gas Detection System (F&G) shall be to safeguard personnel, plant equipment and the environment by:

- Monitoring designated areas for presence of flammable and toxic gases (if any) or fire by the use of fire and gas detectors.
- Initiating alarms on fire and/or gas detection, and communicated across the affected facility to alert personnel.
- Activating automatic fixed fire-extinguishing systems (if any).
- Monitoring buildings for smoke, flammable and/or toxic gases
- Automatic safety process actions (shutdown/blow down) to limit escalation of the hazardous event.

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 14 از 28	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

The alarms and actions generated by the activation of each detector shall be detailed in Fire and Gas Causes and Effects Charts.

7.2 INTERFACES OF THE F&G/FIRE ALARM PANEL WITH OTHER SYSTEMS/UNITS

The F&G Detection System/Fire Alarm Panel shall be interfaced with other systems/units of the compressor station:

- Interfaces with the ESD system.
- Interfaces with the DCS (serial link).
- Interface with the HVAC system and CO2 package
- Interface with Packages UCPs (if any)

Refer to Control/ESD/F&G Sys. Block Diagram Configuration, Doc No. BK- GCS-PEDCO-120-IN-BD-0001, for more details.

7.2.1 INTERFACES WITH THE ESD

The signals interfaced with the ESD system shall be hardwired.

7.2.2 INTERFACES WITH OWS/EWS

F&G System shall be connected to OWS for monitoring and EWS for configuration by LAN communication (provided by DCS Vendor)

7.2.3 INTERFACES WITH THE HVAC AND CO2 PACKAGE



The interfaced signal with the HVAC and CO2 package shall be hardwired.

7.2.4 INTERFACE WITH PACKAGES UCPS (IF ANY)

All commands to packages UCPs and all signals from packages UCPs shall be HARDWIRED.

7.2.5 ADDRESSABLE FIRE ALARM SYSTEM

All addressable detectors inside buildings shall be connected to Addressable Local Fire Alarm Control Panel which will be located inside the control building . Smoke detectors, Heat detectors, indoor manual call points and Fire horns and etc. (except Gas detectors inside the buildings) shall be addressable type. Conventional detectors shall be connected directly to F&G system.

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 15 از 28	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

FACP shall be microprocessor-based fully addressable system. It shall be capable of controlling all alarm functions within building.

7.3 OPERATOR WORKSTATION (OWS)

Single monitor workstation (32") to be used as common for ESD/F&G systems with industrial keyboards and roller ball for operation of ESD/F&G system (provided by ESD vendor).



7.4 SELECTION OF DETECTORS

The selection of detectors, principle of operation, quantity and location shall consider the predominant combustible/flammable/toxic materials presence, the type of fire which may occur and the possible presence of flammable and/or toxic gases, together with the following:

- The ambient conditions and possible causes of impaired performance.
- Dispersion behavior of smoke and gas and the possible locations for fire and gas detectors, such as areas where there may be insufficient air changes.
- Ventilation air flow patterns.
- Shielding by beams, equipment or piping.
- Possible failure modes, including risk of accidental damage, consequences of failure and the probability of false alarms.
- Maintenance requirements including access frequency and duration.
- Performance requirements including performance standards and the speed of response to a developing hazard.

Elements that can influence the efficiency of the Detection and Alarm Systems shall be taken into account. Those shall include, but not be limited to, the following:

- Maximum and minimum temperatures.
- Wind direction and velocity.
- Low elevation sun conditions.
- Obscuration by mists, dusts and other causes of poor visibility.
- Excessive rain.
- Presence of pollutants.
- Expansion and contraction of support arrangements due to ambient temperatures and sunlight.
- Explosion hazards.
- Mechanical stress and vibrations.
- Noise levels.
- Electromagnetic influences.
- Mechanical damage.
- Plant obstructions.

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان:	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 16 از 28	
053 - 073 – 9184	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

7.5 DETECTORS VOTING LOGIC

To safeguard against initiation of safety measures on a false basis, it is common to require two fire or gas detectors or more in some area to operate before this is initiated.

Signal from any one detector should always give an alarm.

It is important that the detectors involved are located such that both will sense the fire development or gas release sufficiently fast to enable the safety measures to be initiated before the fire has developed to a critical level or gas leakage become critical.

Voting describes the philosophy of utilizing combinations of actuated detectors to provide alarms and executive actions.

The proposed ESD system has to be certified by a recognized certifying authority for use in safety & shutdown application, and shall satisfy the class SIL3. The method of voting may include two-out-of-n (2ooN), which requires two detectors, out of a group of N ($N \geq 3$), to operate to provide an executive action and alarm.

The gas detectors are voted in a 2ooN configuration.



It shall be noted that manually operated controls shall not be voted.

Cross-zone describes two different cross loops being activated (i.e. smoke detectors connected to total flooding clean agent extinguishing systems if any) on the same zone to provide an executive action and alarm.

8.0 FIRE DETECTION SYSTEM

8.1 GENERAL

- Fire in the plant can generally take place due to the ignitions of flammable material such as ignition of released hydrocarbon from the system or ignition of furniture, cable, etc. in the plant and building areas.
- Fire detection system shall be provided with automatic devices for detection of smoke, heat or flame that may be generated from any kind of fire and with manual alarm call points that give the information of any fire by any personnel.
- Adequate number of fire detectors and manual alarm call points shall be provided in the plant areas as well as building areas to cover each designated fire zone based on the viewing angle of the detector selected and manufacturer's instructions. Fire detectors have an optical system which looks at the flame and so they need a clear line of sight path.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک							
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 17 از 28
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	
							D06	

All materials and equipment's associated with Fire & Gas detection/control shall be suitable for being used within Zone 2 hazardous area and the prevailing environmental conditions (Refer to Specification for Hazardous Area Classification Doc. No.: BK-GNRAL-PEDCO-000-SA-SP-0002)

Field devices shall be certified for electrically hazardous environment Zone 2, Class IIB, T4 as minimum and ingress protection IP65 (Refer to Specification for Hazardous Area Classification Doc. No.: BK-GNRAL-PEDCO-000-SA-SP-0002).

8.2 FIRE DETECTION DEVICES IN OPEN AREA

UV/IR Flame detector shall be used in general area where flame are expected to be one of the prime indications of fire, such as; open outdoor areas, hydrocarbon areas and fuel areas and generally in strategically locations to view equipment as primary means of fire detection. In locating the fire detectors, the environmental criterion shall be taken into account such as sunrise, sunset, dust, humidity, vibrations and alignment. (IR or IR3 type flame detectors shall be used in enclosed areas where the smoke and heat detector limitations do not permit their application)

Sufficient detectors shall be provided to cover each designated fire zone based on the viewing angle of the detector selected and manufacturer's instructions.

Field of view for flame detector shall be considered Minimum 120° (as per datasheet).

Detectors shall be suitable for use in classified area which they are installed based on Specification for F&G detectors.



Exception of the equipment's which are protected by linear heat detectors other areas like as Feed pumps area, Exchangers area, Heater area shall be monitored by flame detectors.

When one of the flame detectors is activated in open area, the following alarms and action shall be started:

- Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room.
- Continuous Audible /Red Visual Alarm and Actions in concerned area.

When two of the flame detectors (2oo3) are activated in open area, the following alarms and action shall be started:

- Continuous Audible /Red Visual Alarm and Actions in total plant.
- Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room.
- ESD shut down as per F&G cause and effect diagram and ESD philosophy of the project.
- Deluge system release in the concerned area.

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 18 از 28	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

8.3 FIRE DETECTION DEVICES IN BUILDING

Combination rate-of-rise and fixed-temperature heat detectors and also point type smoke detectors for buildings shall be installed on ceilings, false ceiling and false floor, Accordance with manufacturer's specifications and NFPA 72 and relevant IPS standards.

Remote indicator shall be provided for those located on false ceiling & floor.

The maximum coverage of detectors shall not be greater than 25m² for Heat and 50m² for smoke detectors (IPS-E-SF-260).

8.3.1 HEAT/SMOKE DETECTOR IN BUILDING

Typically, point type rate-of-rise heat detectors and also point type optical smoke detectors shall be selectively located in buildings of low fire hazards.

- Rate of rise heat detector shall be used where fire are expected to generate heat such as pantry room.
- Spot type smoke detector shall be provided for manned building like as office rooms, HVAC room, Corridors, Prayer room, Dressing room, Guard room & Cylinder rooms.

When one of the Heat/Smoke detectors is activated in building, the following alarms and action shall be started:

- Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room.
- Continuous Audible/ Red Visual Alarm and Actions at Building.

When two of the Heat/Smoke detectors are activated in building, the following action shall be started:

- Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room.
- Continuous Audible/ Red Visual Alarm and Actions at Building.
- HVAC shut-down and dampers closed in concerned fire zone (if any).
- Extinguishing systems Activation (if any).

8.3.2 FIRE DETECTION DEVICES ON TRANSFORMERS

Linear Heat detection cables shall be provided for transformers area in the substation building for started the water spray system(if any) so, In addition of above alarm and action when any linear heat detector activates in transformer area, bellow actions shall be started:

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>							
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 19 از 28
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	
							D06	

- Continuous Audible/ Red Visual Alarm and Actions at Building.
- Audible/ Visual Alarm on F&G system, operating console and /F&G Matrix panel in Operator Room.
- Transformers shut down.

9.0 GAS DETECTION SYSTEM

9.1 GENERAL

The flammable and toxic gas detection system shall provide continuous and automatic monitoring for the presence of flammable and toxic gases in specified areas.

The type of detector and its location should be based on typical leakage and equipment layout and the heat and material balance statistics for the process.

General guidelines and requirements for location are given below.

- Prevailing wind speed and direction and local atmospheric conditions (dust, humidity, alignment...) should be considered.
- Potential leakages sources shall be determined in plant.

The elevation at which the gas detectors are mounted shall reflect the presence of heavier or lighter-than-air gases. Consideration should be given to the molecular weight of the gas mixture in the various parts of the process, and whether a lighter or heavier-than-air gas leak would result in case of a leakage.;

➤ For gas lighter than air:

Location of detectors shall be at a height of 500~700 mm above the Potential leakages source

➤ Gas heavier than air :



Location of detectors shall be at a height of 500~700 mm above ground level

Flammable gas detector:

- Accuracy : < +/-3% full scale
- Availability : < ± 2% full scale

Toxic gas detector:

- Accuracy : ± 2% of full scale
- Availability : < ± 2% full scale

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 20 از 28	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

9.2 FLAMMABLE GAS DETECTION DEVICES IN OPEN AREA

In open area, infrared flammable gas detectors (IRGD) shall be installed for all process equipment which may cause gas leakage.

To allow a level of redundancy, the minimum number of detectors in any one fire area shall be two, wired on separate circuits (2oo3 voting logic). This will allow for a single detector failure or fault. Detection by two or more devices at high level in the same voting group shall constitute a 'confirmed' alarm.

Respective thresholds to indicate Low/High level for flammable gas detectors shall be set at 20% & 50% LEL as Low & High levels for hydrocarbons.

When 20% LEL unconfirmed alarm of one flammable gas detector is activated, the following alarm shall be started:

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Non-continuous Audible /Yellow Visual Alarm and Actions in concerned area.

When 50% LEL unconfirmed alarm of one flammable gas detector is activated, the following alarms shall be started:

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
 - Continuous Audible /Yellow Visual Alarm and Actions in concerned area.
- And when 20 % LEL or 50 % LEL confirmed alarm of two gas detectors (voting 2ooN) are activated, the following alarms and action shall be started:

- Non-continuous Audible /Yellow Visual Alarm and Actions in concerned area (only in 20% LEL).
- Continuous Audible /Yellow Visual Alarm and Actions in total plant (only in 50% LEL).
- Common Audible/ Visual Alarm on F&G system, operating console in Operator Room
- Common Audible/ Visual Alarm on F&G Matrix panel in Operator Room
- ESD Shut down as per F&G cause and effect diagram and ESD philosophy of the project.(only in 50% LEL)

9.3 FLAMMABLE GAS DETECTION DEVICES FOR DIESEL GENERATOR(IF ANY)

For diesel generator shed, three flammable gas detectors shall be provided in Diesel Room.

When 20% LEL unconfirmed alarm of any detector is activated, the following alarms and action shall be started:

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>							
شماره پیمان:	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 21 از 28
053 - 073 – 9184	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	D06

in Operator Room

- Non-continuous Audible /Yellow Visual Alarm and Actions in concerned area.

When 50% LEL unconfirmed alarm of any detector is activated, the following alarms and action shall be started:

- Continuous Audible /Yellow Visual Alarm and Actions in concerned area.
- Continuous Audible /Yellow Visual Alarm and Actions in total plant (only in 2oo3 voting).
- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Emergency shutdown of the machine (only in 2oo3 voting).

9.4 FLAMMABLE GAS DETECTION DEVICES IN BUILDING

Three Flammable gas detectors shall be provided for HVAC system at each air intake and air lock for buildings. When 20% LEL unconfirmed alarm of one flammable gas detector is activated, the following alarms and action shall be started:

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Non-continuous Audible /Yellow Visual Alarm and Actions in concerned area.

When 50% LEL unconfirmed alarm of one flammable gas detector is activated, the following alarms and actions shall in addition

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Continuous Audible /Yellow Visual Alarm and Actions in concerned area.

And when 20% LEL or 50% LEL confirmed alarm of two gas detectors (voting 2ooN) are activated, the following alarms and action shall be started:

- Non-continuous Audible /Yellow Visual Alarm and Actions in concerned area (only in 20% LEL).
- Continuous Audible /Yellow Visual Alarm and Actions in total plant (only in 50% LEL
- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- ESD shut down as per F&G cause and effect diagram and ESD philosophy of the project (only in 50% LEL)
- HVAC shut-down and dampers closed (if any and only in 50% LEL).

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک							
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 22 از 28
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	
	D06	0001	DC	IN	120	PEDCO	GCS	BK

9.5 TOXIC GAS DETECTION IN OPEN AREA

The measurement principle used can be of a semi-conductor (Electrochemical cell Type) with temperature maintained in the semi-conductor.

The characteristics of the probe shall be clearly specified as a function of changes to the environmental conditions (hygrometry, temperature and pressure).

H₂S detectors shall be located at HVAC inlets to all occupied areas and in process areas where sour gas is being handled.

HVAC inlets shall be provided with three detectors as a minimum with 2oo3 voting. Action levels shall be set at 10ppm and 20ppm. At 10ppm by two detectors will register in the control room and allow a warning announcement to be made over the bells and a toxic gas alarm raised and at 20 ppm by two detectors allows a warning announcement to be made over the sounders and the HVAC shall be shut down.

H₂S detectors shall be located in sour gas processing areas at low level where gas could accumulate. Typically:

Significant areas of pipework where control and isolation valve seals are located and large numbers of flanges or screwed joints are present in the containment systems.

The alarm levels for the detectors shall be set at 10ppm and 20ppm.

When 10 ppm unconfirmed alarm of one gas detector is activated, the following alarms and action shall be started:

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Non-continuous Audible /Blue Visual Alarm and Actions in concerned area.

When 20 ppm unconfirmed alarm of one gas detector is activated, the following alarms and action shall be started

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Continuous Audible /Blue Visual Alarm and Actions in concerned area.

And when 10 ppm or 20 ppm confirmed alarm of two gas detectors (voting 2ooN) are r activated, the following alarms and action shall be started:

- Non-continuous Audible / Blue Visual Alarm and Actions in concerned area (only in 10ppm).
- Continuous Audible /Blue Visual Alarm and Actions in total plant (only in 20ppm).

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA								شماره صفحه : 23 از 28
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- ESD Shut down as per F&G cause and effect diagram and ESD philosophy of the project.(only in only in 20ppm)

Toxic gas detection will however continue to monitor the area of concern for increased gas build up.

The characteristics to be specified include the following, at a minimum:

- The zero stability in ppm per month with the measurements, hygrometry, temperature and pressure held constant.
- The zero drift in ppm per month as a function of the hygrometry at 20°C and 1013 mb. The deviations between 20% and 100% of the Relative Humidity (RH) shall be stated
- The zero drift in ppm per month as a function of the temperature at 50% RH and 1013 mb. The deviations between -20°C and +40°C shall be stated
- The zero drift in ppm per month as a function of the pressure at 50% RH and 20°C. The deviations at 1013±50 mb shall be stated
- The sensitivity drifts in ppm in the above conditions
- The sensitivity drifts when the probe has not been in contact with the gas to be detected for six months
- The sensitivity drifts when the probe has been in contact with the gas to be detected at 50% of the mean allowable concentration for one month
- The guaranteed operating life of the sensor shall not be less than two years, even in the presence of Freon, silicone and tetraethyl leads (TEL and TML)
- Use of physical or chemical filters before the sensors shall only be accepted if the sensor's sensitivity and detection speed are not altered by same

The transmitters shall be smart type and communication protocols shall be approved by the client.


The transmitter signal shall be 4-20 mA and their accuracy shall be better than ±0.1% of span.

9.6 TOXIC GAS DETECTION DEVICES IN BUILDING

Three Toxic Gas gas detectors shall be provided for HVAC system at each air intake and air lock for buildings. When 10 ppm unconfirmed alarm of any gas detector is activated, the following alarms and action shall be started:

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Non-continuous Audible /Blue Visual Alarm and Actions in concerned area.

When 20 ppm unconfirmed alarm of any gas detector is activated, the following alarms and action shall be started

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 - 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 24 از 28	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Continuous Audible /Blue Visual Alarm and Actions in concerned area.

And when 10ppm or 20ppm confirmed alarm of two gas detectors (voting 2ooN) are activated, the following alarms and action shall be started:

- Non-continuous Audible / Blue Visual Alarm and Actions in concerned area (only in 10ppm).
- Continuous Audible /Blue Visual Alarm and Actions in total plant (only in 20ppm).
- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- ESD shut down as per F&G cause and effect diagram and ESD philosophy of the project (only in 20ppm).
- HVAC shut-down and dampers closed (if any and only in 20ppm).

9.7 HYDROGEN DETECTION IN BATTERY ROOM

Hydrogen gas detectors shall be installed in battery room. The hydrogen gas detector is designed to allow dissipation and give warning before any concentration reaches the lower explosive limit 5% LEL. When at least 5% LEL hydrogen is present in the air:

- Non-continuous Audible /Yellow Visual Alarm and Actions at Building
- Common Audible/ Visual Alarm on F&G system, operating console and/ F&G Matrix panel in Operator Room
- Start duty exhaust fan

When at least 10% LEL hydrogen is present in the air:

- Continuous Audible /Yellow Visual Alarm and Actions at Building
- Common Audible/ Visual Alarm on F&G system, operating console and /F&G Matrix panel in Operator Room
- Isolation of battery feeder and Shutdown of battery boost charging (only in 10% LEL)

If three hydrogen gas detectors has been considered in battery room, voting for alarm and action to be assumed as follows (When 5% LEL or 10% LEL confirmed alarm of two hydrogen gas detectors (voting 2ooN) are activated):

- Non-continuous Audible /Yellow Visual Alarm and Actions at Building (only in 5% LEL).
- Continuous Audible /Yellow Visual Alarm and Actions in total plant (only in 10% LEL).
- Common Audible/ Visual Alarm on F&G system, operating console and /F&G Matrix panel in Operator Room
- Isolation of battery feeder and Shutdown of battery boost charging (only in 10% LEL).
- Start stand by exhaust fan (only in 10% LEL).

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>							
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 25 از 28
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	
							D06	

Detectors for battery room shall be certified based on Specification for F&G devices.

10.0 MANUAL CALL POINTS

Manual call points shall be of the resettable type with single pole change over switch (equipped with opening key for test, maintenance and reset). The complete housing of manual call points installed outdoors shall be constructed in accordance with requirements for the classified areas based on Specification for F&G devices be corrosion- resistant and fully weather- proofed.

Manual alarm call points shall be used only for alarm initiating purposes to provide alarm points in emergency situations and to supplement the automatic fixed fire detection systems.

Each manual alarm call point shall be installed 1,4 m above the finished ground, surface mounted on the wall, shelter, structure or stand.

Manual call points shall be clearly recognizable from a distance and should be positioned as follows:

- Along roads in the plant area at intervals exceeding 60 m, preferably at or near to logical escape routes and access ways.
- Near or at locations having a higher risk such as slug catchers, manifolds, launching and receiving area.
- Entrance of the plant near the gate house.

At near the building entrance, inside the buildings at corridors and exit door of rooms at intervals not exceeding 30 m. Operation of a manual alarm call point in buildings, shall initiate:

- Continuous Audible /Red Visual Alarm and Actions in concerned area.
- Common Audible/ Visual Alarm on F&G system, operating console and /F&G Matrix panel in Operator Room

Operation of a manual alarm call point in open areas, shall initiate:

- Continuous Audible /Red Visual Alarm and Actions in concerned area.
- Common Audible/ Visual Alarm on F&G system, operating console and /F&G Matrix panel in Operator Room

11.0 ALARMS & LIGHTS DEVICES

Alarm sounder and flash lights shall be provided for outdoor locations. The sound level shall be selected such that the alarm can be clearly audible and distinguishable. The alarm sound level shall be suitable for personnel warning in industrial environment where other machinery noises are already present. The sounders shall have different tones so that F&G audio alarm and extinguished pre-alarm can be distinguished. The electronic sounders shall have an output of 117 dB within a

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA								شماره صفحه : 26 از 28
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

frequency range of 500 ~ 1000 HZ at a radius of one meter with a built-in gain control to adjust the volume and facility to select the tones.

Accordingly; Audible alarm for open area shall be at least 117 dB(A) at 1m away.

In open area, where noise level doesn't permit application of sounder consideration shall be given to visual flashing light. Different type of hazard such as; toxic/ flammable concentration or fire shall be indicated in suitable plant area location with flashing frequency of 60 flashes / minute by different colors.

The beacon colours shall be as follows:

- Red for fire detection
- Yellow for flammable gas detection
- Blue for toxic gas detection(if applicable)

And audible alarms shall be:

- non-continuous for flammable and toxic gas low alarm detection
 - Continuous for fire detection and also flammable/toxic gas high alarm detection
- Bells shall be installed in corridors and inside of the buildings for warning the personnel in a building. In case of fire in each fire zone inside of a building it will be activated based on a 100N voting. It should have 110 dB sound pressures.
- Bells or sounders shall be of adjustable type.
- For the protected room by gas extinguishing system in the building a horn shall be installed at above the exit door of for each protected area. Horn sound level shall be 110 dB suitable for personnel warning in industrial environment where other machinery noises are already present. The horn shall be with provisions to alarm different sound levels. The multiple wire cable shall be terminated in the horn terminals. The terminals shall be housed in an explosion proof enclosure as part of the horn. The sound level for the horn shall not exceed 110 dB (A) at 1 meter distance on the main axis.

12.0 DETECTION LAYOUT

Location of Fire & Gas Sensors and Devices shall be in accordance to standards: IPS-E-SF-260 & IPS-G-IN-270

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>							
شماره پیمان: 053 - 073 - 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 27 از 28
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	PEDCO	120	IN	DC	0001	
							D06	

13.0 SPARE PARTS AND SPECIAL TOOLS

13.1 SPARE PARTS

The VENDOR shall provide lists of recommended spare parts, which shall include the original part numbers with prices for commissioning, start-up and two years operation. All spare parts shall be identified individually.

Spare parts for commissioning and start-up; a qualified and complete list based on PROJECT SPARE PART SUPPLY PROCEDURE (Doc. No. E&D-QC-SP-1).

Spare parts for two years operation; a qualified and complete list based on PROJECT SPARE PART SUPPLY PROCEDURE (Doc. No. E&D-QC-SP-1).

Vendor shall be able to provide spares back up and support for the plant life for at least 15 years.

SPIR form shall be approved by CLIENT prior to procurement.

13.2 SPECIAL TOOLS

The VENDOR shall submit, with his quotation, his recommendations for one set of special tools required for test, installation and maintenance of the supplied equipment (if any).

Calibration certificate shall be provided for all special tools and calibration equipment. These certificates shall be valid for test and calibration of F&G detectors required accessories shall be provided.

Calibration amount such as % LEL, PPM, ...of F&G detectors to be advice by vendor.


For flame, flammable gas, Toxic, Smoke and heat, open path, hydrogen and all other type of detectors, Test facility and materials such as sample gas capsules,... shall be provided and certified to be usable for as minimum 2 years after plant start-up.

13.1 SPARE POLICY

20% spare for bulk material (tube & fitting JB, cable accessories, cable ladder & tray etc.) shall be considered. The supplied two years spare parts shall be extended to consider the replacement cards and kits of different instrument.

14.0 TRAINING

Vendor shall arrange training courses in standard training facilities for as a minimum 8 person containing the details about operation and maintenance of F&G system and facilities.

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 - 073 – 9184	FIRE & GAS DETECTION DESIGN CRITERIA							شماره صفحه : 28 از 28	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	PEDCO	120	IN	DC	0001	D06	

15.0 GUARANTEE & WARRANTY

VENDOR shall be fully responsible for the manufacture in respect of proper design, quality, workmanship and operation of all the equipment, accessories etc. including supplied by sub-contractors/VENDORS. This includes both hardware and software. Guarantee conditions and warranty period shall be as stated in the commercial section documents.

It shall be obligatory on the part of VENDOR to modify and/or replace any hardware and modify the operating, application and diagnostic software free of cost, in case any malfunction is revealed even during on-line operation after taking over, within the warranty period.

The Systems shall be guaranteed against malfunction, partial or complete failure resulting from or attributed to the following:

- Sub-standard components and materials.
- Incorrectly rated components and materials.
- Sub-standard workmanship, including but not limited to sub-standard design, construction, alignment, and setting-up.
- Adjustments carried strictly in accordance with VENDOR's manuals or written instructions where those manuals of instructions are in error.

VENDOR shall assume full responsibility for his Sub-VENDORS of equipment and ancillaries supplied under this specification i.e. individual equipment warranties etc. are not to be signed over to the CONTRACTOR but will remain that of the equipment package VENDOR.

If poor performance occurs or defects are found during the warranty period, VENDOR shall make all necessary alternations, repairs and replacements, including shipment of parts and mobilization of assistance, free of charge.

The guarantee period shall be eighteen (18) months from the date of delivery or twelve (12) months from the installation date of each equipment/packages at site.

VENDOR is to provide a list of parts and state for each the replacement time and repair turnaround time under warranty.