

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Fire & Gas System								
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Specification for Fire & Gas System

AFC

APPROVED FOR CONSTRUCTION

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Status:

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

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1. INTRODUCTION

National Iranian South Oil Company (NISOC) plans to conduct an integrated project includes several sub-projects to preserve and increase production of Gachsaran oil fields located in south of Iran Khuzestan and Bushehr provinces as follow:





- 1) Revamping of Production and Desalting Units of Bibi Hakimeh 1&2
- 2) Fabrication & Installation a Preheater, Stripping Column and Related Equipment for Nargesi Production Unit

The purposes of first sub-project are equipping and extension of Bibihakime-2 desalting unit to achieve 110,000 SBPD desalted crude oil, and necessary modifications in Bibihakime-2 desalting & production units and Bibihakime-1 production unit so that the new plants will be able to process crude oil with 22% water cut and transfer waste water from Bibihakime-1 production unit to waste water treatment facilities in Bibihakime-1 desalting unit via installation of a none-metal pipe. Therefore, National Iranian South Oil Company (NISOC) has announced this project.

The purpose of second sub-project is crude oil sweetening in Nargesi plant by new design and necessary modifications in existing facilities. National Iranian South Oil Company (NISOC), on behalf of the National Iranian Oil Company (NIOC) is responsible to exploit oil and gas from onshore fields in the south district of Iran. According to management of planning & international affairs of National Iranian Oil Company (NIOC) pronouncement, H₂S content and RVP specification of exported oil shall be in the specified allowable range; Accordingly, NISOC has decided to fulfil a project, investigating and probing required equipment and operational conditions to meet the desired crude oil specifications of sulphur content and RVP for Nargesi production units.

2. SCOPE

This specification defines the minimum technical information required to carry out the engineering design for fire and gas detection and alarm system of “Revamping of Production and Desalting Units of Bibi Hakimeh 1&2” and “Fabrication & Installation a Preheater” Stripping Column and Related Equipment for Nargesi Production Unit” sub-projects.

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This specification covers the minimum requirements for design, manufacture, supply, inspection, testing, and pre-commissioning of the system.

3. DEFINITIONS

Within the context of this document, the following definitions are applicable

Owner/Client	: National Iranian south oil company (NISOC)
Title	: Development Plan of 28 Reservoirs/ BIBI HAKIMEH Oilfield (EPC)
Contractor	: Mashin Sazi Arak/ Sealand Engineering and Well Services JV
Consultant	: Tehran Raymand Consulting Engineers
Will:	Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.
May:	Is used where a provision is completely discretionary
Should:	Is used where a provision is advisory only.
Shall:	Is used where a provision is mandatory.




4. ENVIRONMENTAL CONDITIONS

4.1. Site Condition

All the environmental data used in this document and is expected to be considered, shall be obtained from “Process Design Basis for Bibi Hakimeh Production Unit No.1_BH-17-SM-100-PR-DB-0158”, “Process Design Basis for Bibi Hakimeh No.2_BH-17-SM-100-PR-DB-0564” and “Process Design Basis for Nargesi_BH-18-SM-100-PR-DB-0002”.

4.2. Tropicalization

The instruments shall be tropicalized to eliminate mildew, fungi and other detrimental effects of a tropical environment and dust, if needed. Electronic circuit boards shall be suitably protected against corrosion and humidity by applying a protective coating, where deemed necessary. Packaging shall be suitable for shipment and storage under tropical conditions.

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4.3. Ingress Protection

All field mounted equipment shall be suitable for the environmental conditions. Particular attention shall be paid to possible effects of corrosion, vibration, humidity, and extremes of temperatures.

5. CONFLICTS AND DEVIATIONS

Any conflicts between this specification and other applicable specifications, engineering standards, industry standards, codes, etc., shall be resolved in writing by the Owner or Owner's Representative.

6. REFERENCES

6.1. Project Documents

Instrument & Control/Safety System Design Criteria: BH-17-SM-100-IN-DC-0052

Specification for Panels and Cabinets_ BH-17-SM-100-IN-SP-0056

HSE Design Criteria_ BH-17-SM-100-SA-DC-0134

Safety Philosophy_ BH-17-SM-100-SA-PH-0136

Specification for Fire & Gas Detection_ BH-17-SM-100-SA-SP-0059

Process Design Basis for Bibi Hakimeh Production Unit No.: BH-17-SM-100-PR-DB-0158

Process Design Basis for Bibi Hakimeh No.2: BH-17-SM-100-PR-DB-0564




Process Design Basis for Nargesi: BH-18-SM-100-PR-DB-0002

6.2. References Standards

The codes and standards which are listed below shall be followed as applicable:

➤ International Standards





API RP 552	Transmission Systems
IEC 60079	Electrical Apparatus for Explosive Gas Atmosphere
IEC 60092	General Instrumentation, Control and Communication Cables
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)

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IEC 61000	Electromagnetic Compatibility (EMC)
IEC 61131	Programmable Controllers
IEC 61508	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems
ISA 84.01	Application of Safety Instrumented Systems for the Process Industries
BS 5445	Specification for Components of Automatic Fire Detectors
BS 5839	Specification for Fire Detection and Alarm Systems for Buildings
NFPA 72	National Fire Alarm Code

➤ IPS Standards

IPS-E-IN-190	Engineering Standard for transmission Systems
IPS-C-IN-190	Installation and Construction Standard for transmission Systems
IPS-M-IN-190	Material and Equipment Standard for transmission Systems
IPS-G-IN-220	Engineering and Installation Standard for Control Centers
IPS-M-IN-220	Material Standard for Control Panels and System Cabinets
IPS-G-IN-290	Engineering and Construction Standard for Programmable Logic Controllers (PLC)
IPS-M-IN-290	Material and Equipment Standard for Programmable Logic Controllers (PLC)
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 Alarm Systems



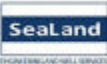

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7. BASIC PRINCIPLES




7.1. Acronyms and Abbreviation

The following abbreviations are commonly used in this document:

AI	Analog Input
AO	Analog Output
ANSI	American National Standard institute
API	American Petroleum institute
ASTM	American Society for Testing and Material
ATEX	Atmosphere Explosible
AWG	American Wire Gauge
BMS	Burner Management System
BS	British Standards
CENELEC	European Committee for Electrical Standardization
CPU	Central processing Units
CCR	Central Control Room
dBA	Decibel Absolute
DC	Direct Current
DCS	Distribute Control System
DI	Digital Input
DO	Digital Output
DPDT	Double Pole Double Throw
EEX	Europe Explosion Proof
EMC	Electromagnetic compatibility
EMI	Electromagnetic Interference
ESD	Emergency Shut Down
EWS	Engineering Work Station
FAT	Factory Acceptance Test

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FGS	Fire and Gas System
F.S.	Full Scale
HMI	Human Machine Interface
I&C	Instrumentation and Control
IEC	International Electrotechnical Commission
I/O	Input/output
IP	Ingress Protection
IPC	Industrial Personal Computer
IPS	Iranian Petroleum Standard
I.S.	Intrinsically Safe
ISA	International Society of Automation
ISO	International Standard Organization
JB	Junction Box
MCC	Motor Control Center
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NACE	National Association of Corrosion Engineering
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NPT	National Pipe Thread
OWS	Operator Work Station
OD	Outside Diameter
LED	Light Emitting Diode
P&ID	Piping and Instrumentation Drawing
PCS	Process Control System
PLC	Programming Logic Controller
RFI	Radio Frequency Interference
RTD	Resistance Temperature Detector
SI	System International of Units

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SPDT	Single Pole Double Throw
UCP	Unit Control Panel
UPS	Uninterruptible Power Supply
UV	Ultra Violet

7.2. Units of Measurement

Generally, International System of units (SI) shall be used. All dimensions and ratings shall be metric. Except for the temperature, which shall be in degrees Celsius instead of Kelvin, and for pipes and fittings threads, which shall be in inches of NPT.





Variable	Units
Temperature	Celsius degree (°C)
Pressure Relative	Psig or Barg
Pressure Absolute	PsiA or barA
Level	m or mm, % of range
Flow	Liquid kg/h or m ³ /h
	Gas or vapor m ³ /h or Sm ³ /h(l) or kg/h
	Air or nitrogen m ³ /h or Sm ³ /h(l) or kg/h
Analysers	pH, molar%, ppm % LEL
Density Liquid Gas	Kg/m ³ kg/m ³ .Or.kg/Sm ³ (l)

8. GENERAL SYSTEM REQUIREMENTS

Fire And Gas Detection System shall be designed to ensure the safety of personnel, safeguard the environment and to provide for the protection of the plant and its associated facilities, and to permit the continuity of production.

8.1. Vendor Responsibility

The Vendor shall be totally responsible for the design of the system including all materials used in its manufacture, performance, construction, inspection and testing, all of which shall fully comply with the performance and other requirements as detailed in this specification and associated documentation.

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In addition, the Vendor shall ensure that the system design and all components comply with all relevant codes, standards and regulations whether specifically referred to or not.

The Vendor shall submit a timetable for periodic maintenance, calibration and cleaning of the system and its components.

The Vendor shall provide the following services:

- Project Management/Planning/Reporting,
- Supply of system hardware/software including auxiliary equipment,
- Supply of system & interconnection cables,
- Test and Certification,
- Packing and Shipment,
- Spare Part (Commissioning/Start-up and two years operation) and Consumables,
- Training (Including fundamental, operation, engineering and configuration, programming, Hardware/software maintenance, maintenance and external systems interface),
- Onsite services (System SAT, Installation, Commissioning and Start-up assistance),
- Special Equipment or tools for installation, commissioning, testing, calibration and maintenance,
- System configuration/programming,
- Software updating,
- Factory acceptance test,
- Site acceptance test,
- Documentation,
- Guarantee,
- Quality management requirements

All required software and source codes shall be provided to client after system start-up. It shall be no need to Vendor attendance in case of requirement for re-installation of system software and application programs on the new stations.

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8.2. Deviations

All deviations from the requirements of any of the Data sheets, Specifications, Codes, Standards, Regulations, Guidance Notes, etc, shall be agreed with Client before proceeding.

In the absence of such a statement, it shall be understood that all listed requirements are accepted. Any costs associated with re-engineering and/or provision of additional materials subsequently identified as being required together with re-inspection and re-testing shall be done by the Vendor and the changes incorporated with slippage to neither schedule nor delay in commissioning.

8.3. Approvals

The system shall have approval from international recognized agencies such as UL, FM, BASEEFA, PTB, etc.

8.4. Spares

The Vendor shall supply spare parts for Pre-commissioning, commissioning, and two years of operation. Moreover, the Vendor shall guarantee that he will supply spare parts for his system or instruments whenever required by the Client, up to 10 years.




8.5. Special Tools

The vendor shall supply all special tools necessary for the main and auxiliary equipment for installation, pre-commissioning, commissioning and maintenance.

8.6. Training

FGS Vendor shall provide details of training program, including course outline, training location, the number of participants, duration of training and other relevant items at the bid stage. The vendor considers the following items for training:

- The training program shall cover operation, maintenance and configuration topics.
- The training program shall cover all areas of delivered hardware and software.
- The training shall be performed in English or Persian (documents and courses).
- The proposed training shall match the revision level of the software and hardware delivered.
- The vendor shall state the terms and conditions of training include the duration of each course, the minimum and maximum number of students per course, the locations where the courses

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will be offered, any equipment requirement, the transportation, loading and out-of-pocket costs which will be incurred by the purchaser.

- The vendor shall provide comprehensive documentation, course materials, technical notes, manuals, video cassettes, literature and other materials as required for the effective implementation of the training curriculum.
- All such training materials shall become the property of the Owner. The vendor shall be required to update the course material documentation, technical notes and manuals in the event of changes due to revisions or modifications to the system as delivered.
- The Owner shall approve the training proposal and reserves the right to request changes in the program. The training shall include a detailed and comprehensive overview, descriptions of the configuration programs and the configuration files, descriptions of program and associated subsystem programs, and theory of operation.
- Training courses shall be arranged before FAT.
- User manual of system shall be provided in English and Persian language and installed locally by vendor.

8.7. Hazardous Area Classification




Electrical and electronic equipment for installation in hazardous area zones shall be selected and designed in compliance with the defined hazardous area classification. And shall be certified in accordance with the definitions given in IEC 60079 'Electrical Apparatus for Explosive Gas Atmospheres' ATEX European Directives shall be followed.

8.8. Earthing

Vendor shall fully describe the preferred method for grounding power, signals and signals shields in the system proposal. In particular, the Vendor shall indicate the effect of equipment installation in different locations on the grounding design.

The conductive part of instrumentation equipment installed in the ER and CCR building shall be connected to a specific earth loop which is connected to the main earth loop through existing earth dispatchers.

In order to avoid electronic noise and interference, the instrument earth shall remain totally isolated from the electrical protective earth. The impedance of the instrument earth shall be less than 1 ohm.

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Three separate and independent earthing systems shall be provided as required:

- Chassis (electrical) earth Bonded to the structure and utilized for electrical safety of metal enclosures and chassis on all instrument and electrical components.
- Instrument (I.S.) earth Insulated from the structure and other metal work and utilized for I.S. instrument signal screens.
- Instrument (N.I.S.) earth Insulated from the structure and other metal work and utilized for Non I.S. instrument signal screens.
- Screening shall be grounded at the control panel and insulated in the field.
- Three separate and independent reference earths shall be provided for electrical earth, instrument IS earth and instrument NIS earth.

8.9. Surge Protection

Vendor shall ensure that system hardware is suitable to withstand voltage surges.

8.10. Electromagnetic Compatibility

The design of the FGS shall be such that equipment counted inside is not adversely affected by electromagnetic interference as defined in IEC 60801.

The equipment shall not suffer from radio frequency interference.





Electronic equipment shall function correctly in accordance with IEC 60801- Electromagnetic Compatibility.

9. FGS ENGINEERING & DESIGN REQUIREMENTS

9.1. General

Fire and gas detection and monitoring will be realized by means of a Fire and Gas detection and alarm System (FGS), for field mounted devices, and Fire Alarm Control Panels (FACP) for the devices installed for the buildings.

The fire and gas detection and monitoring system (FGS) shall receive signals from field mounted detection devices strategically placed to monitor the potential hazard of fire and the presence of flammable or toxic gases. Fire and gas detection system shall be SIL3 according to

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IEC 61508. Redundancy for logics, power supplies, inputs/ outputs, CPU, and communication hardware shall be provided for FGS.

Addressable fire alarm control panel (FACP) shall be used for the devices assigned to the buildings.

The system logic shall be based on cause-and-effect diagram.

Upon receipt of a confirmed fire and/or gas alarm, the system shall initiate the following actions as defined by the logic:

- Evaluate the signals from the fire and gas detection system, using voting techniques where necessary,
- Activate visual and audible alarm,
- Activate automatic fire fighting systems in emergencies,
- Send signal to ESD system for further automatic action. When emergency shutdown action is required as a result of fire detection, the FGS output shall be routed to the ESD system as a hardwired input, via marshalling cabinet interconnections, and the ESD system shall generate the necessary output,
- Log all FGS actions, including inhibit and overrides.

Central Processor Unit (CPU) of the Fire and Gas Detection and Alarm System (FGS) shall have capability to record 1000 events, as practicable, Vendor shall evaluate and consider any more requirements on the basis of the project documents.




The central processors shall generate all necessary alarm outputs for the zones-fire, fault, etc, and these shall be routed to the Control System (PCS) via data links. The PCS shall log all FGS events, and these shall be visible at the relevant PCS Consoles, in the CR.

All interconnections between FGS with PCS to monitoring of alarms and events shall be via dual serial link communication.

The interface between the FGS and the ESD system shall be established via hardwired signals.

The system shall be designed to be fail safe under all plant operating conditions, however, in the event of any specific items found to be non-fail safe, line monitoring shall be provided.

All electronic equipment shall be immune to radio frequency and electromagnetic interference even when doors or covers are removed for maintenance.

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Vendor shall provide a system block diagram including major components of the system and associated data links.

The interface between the FGS and Total flooding system shall be provided Hardwire and shown in P&ID documents.

The signals required to transfer between new and existing F&G system will be realized in accordance with the safety requirement as will be specified and finalized in Safety documents such as F&G C&E.

9.2. Systems Availability

Overall system reliability/ availability of Fire and gas detection system shall not be less than 99.99%. Vendor shall provide system reliability analysis calculations before processing with manufacture assuming a MTTR of 4 hours and a MTBF of 10 years.

9.3. Electrical Supplies

All FGS components located in CCR and ER shall be powered from the 24 VDC 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 then 5 minutes for activation of all alarming devices). Battery charging shall be automatic, with double battery chargers.

Dual uninterruptible power supply system 110V AC, 50 Hz shall be used for monitors, printers, etc. for a period of 2 hours back-up.




All internal power supplies and power distribution required shall be supplied by the FGS Vendor. These power supplies shall have redundant design and shall be provided with indication for proper operation of the system.

The Vendor shall indicate the consumption of the system as well as the heat dissipation for the relevant panel and cabinet.

A ground fault detection circuitry shall monitor floating electrical circuits in field wiring and alarm when resistance to earth fails.

Each power supply shall have built in diagnostics, circuitry to monitor out of range voltage and over temperature conditions.

Each power supply shall have its own Internal fuse/circuit breaker protection on incoming line size.

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The Vendor shall carry out a fuse co-ordination study to ensure that in case of a short circuit only the protecting fuse or circuit breaker interrupts the circuit and no higher-level fuses are affected.

Regardless of the above, the system shall be unaffected by voltage and frequency variations of up to $\pm 5\%$, and power dips of up to 50 msec. duration.

All other voltages (such as 24 Volt DC, etc) required by the control system and field instruments shall be derived from within the cabinet by the use of suitable internal power supplies and distribution.

Power supplies shall be supplied in redundant configuration and shall be sized 30 % in excess of the estimated maximum demand.

All power supplies over 50 volts shall be shrouded and labelled.

9.4. Electrical Power Distribution




Electrical power distribution for the system cabinets and other system hardware shall form part of the Vendor's scope of supply. Redundant Power supply feeders as specified above will be made available by the Owner for the system. The minimum requirement for the power distribution shall be as below:

- Redundant power distribution boards with incoming fused isolators and miniature circuit breakers for distribution.
- Redundant feeders to all redundant consuming devices.
- Redundant feeders with selector switches for non-redundant consuming devices.
- Power isolation means at both ends of the power cables.

9.5. System Operator Facilities

9.5.1. Matrix Display or Annunciator

A Fire and Gas MIMIC/Matrix Panel along with associated hardware shall be installed in the CCR to provide visual and audible alarm information, as are required as per Safety requirements and stated in Safety documents such as cause and effect charts. It shall be considered as a remote device of the FGS Control Unit. In addition, the annunciator or matrix will be provided with key switches to inhibit output functions. The MIMIC/Matrix Panel shall be installed on FGS

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cabinet door or as a separate panel. The MIMIC/Matrix panel shall be accessible for operator at minimum distance for convenient operation.




The FGS alarm annunciator or matrix shall be provided with a normally lighted green indicator lamp to indicate normal power conditions. A failure of the power system shall cause the green lamp to turn off and the trouble lamp and buzzer as described below to operate. An amber common lamp and trouble buzzer shall indicate a trouble alarm. Conditions that shall cause trouble lamp and buzzer operation are:

- Failure of normal power supply,
- Failure of battery,
- Removal of any detector or contact device from the circuit,
- An open, short circuit or earth short in any input circuit,
- An open, short circuit or earth short in any output circuit,
- Removal of any input / output module.

FGS alarm panels shall be provided with audible alarm devices and silence push buttons. Different tones shall indicate fire, gas and fault alarms, as are required as per Safety requirements and stated in Safety documents such as cause and effect charts.

The matrix panel shall have an input memory so that momentary alarms are maintained until acknowledgement. The FGS matrix panel shall include as a minimum the following alarm feature:

- Indicator lamps for “fire “, “gas” and “test” conditions,
- Any alarm, signal devices or controls required by the NFPA 20; remotely mounted from fire pump controllers, as are required as per Safety requirements and stated in Safety documents such as cause and effect charts.
- Semi graphic displaying the FGS zones with individual zone alarms, as are required as per Safety requirements and stated in Safety documents such as cause and effect charts.
- Indicating lamps for “power on “and “power failure “conditions,
- Lamp test, acknowledge, silence and reset push buttons.

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9.5.2. Engineering Workstation

It is required that all engineering functions and detailed diagnostics be performed via an engineering workstation (EWS) dedicated to FGS.

The levels of security access shall be provided for use of the operator, supervisor or engineer as appropriate. The EWS shall be able connect to an industry LAPTOP. Proprietary (Vendor specific) hardware/software platforms are not acceptable because of their limited use.

The EWS along with its associated configuration software should utilize multi-user, multi-tasking operating environments such as multi-windows, pop-up menus and on-line help.

EWS shall consist of HD LCD display, one flat membrane keyboard, one mouse or tracker ball, DVD-RW and any other items required. The computer electronics shall consist of a microprocessor-based system that supports the keyboard, VDU, drives and printer to transmit and receive data from devices via the data communication system.

All electronics shall be classified for industrial use.




Technical specifications of supplied EWS shall be based on the latest technology. All technical data for the EWS shall be provided by FGS Vendor.

9.5.3. PCS Displays

Operators shall connect with FGS information via PCS workstations. PCS configuration shall include the creation of all necessary displays and reports, both for the process area and for the building. Displays shall include the following requirements as the minimum:

- FGS detector layout graphics,
- These shall include the status of individual sensors in the area, or the zone status, together with the status of any automatic extinguishing systems. These displays shall include wind speed and direction for open areas of the plant.
- FGS overview displays,
- These shall be of matrix type, or arranged geographically, and shall show the FGS status for process area.
- Text displays such as FGS alarm summaries.

All inputs are line monitored.

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9.5.4. Protective Action

The FGS shall initiate a number of protective actions, including operation of extinguishing systems, operation of sprinklers or deluge systems and. All such actions shall be confirmed via inputs to the FGS, and shall be logged and displayed by the PCS.

For any extinguishing system that may be hazardous to personnel, e.g. CO2 total flooding systems, display and selection facilities shall be provided local to the room or building. These shall warn of impending release, release in progress, and release complete, and shall enable release to be locked off when personnel entry is required. All such actions shall be logged and displayed by the PCS.

9.6. I/O Module

9.6.1. Analogue Input Modules

24 VDC, 4 – 20 mA, fail safe, self-testing input modules suitable for internally and externally powered loops shall be provided. Inputs shall have open circuit, short circuit, and out of range detection. Detection results shall be available for use in the application logic, when required.




Where possible analogue inputs shall be 2 wire signals, and powered from the FGS processor cabinet. For analogue inputs using a 3-wire system with loop powering from the detector separate 24 VDC power shall also be available from the processor cabinet.

The analogue input accuracy shall be better than $\pm 0.1\%$ of span.

The flammable Gas Detectors, toxic Gas Detectors, and Flame Detectors shall have integral signal processing to provide three wires 4-20 mA signal inputs to the Logic System.

The FGS analogue input shall be able to perform and generate as a minimum the following facilities for each type of detection loops:

- Detection loop fault (auto test, beam block, over range, etc)
- Open and short circuit line monitoring with generation of fault
- Inhibit facilities for maintenance operation
- Detection loop alarm reset

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9.6.2. Digital Output Modules

All outputs to motors and valves shall be normally de-energized, and shall be line monitored. Outputs shall be isolated, with loop power provided by the FGS. Vendor shall select the appropriate output voltage.

FGS outputs to ESD systems shall be dry (volt free) contacts, powered at 24V DC, or lower, by ESD system. The output contacts shall be closed when the relevant FGS sensors are in the healthy condition.

All outputs will generally be fail-safe except inhibit signal to fire water pumps start command.

Output modules shall provide the following:

- Provide power to the external circuits, as required.
- Potential free (rated 24 VDC, 5 A), where required.

9.6.3. Digital Input Modules

Digital inputs will be signals from volt free contacts powered by FGS using 24V DC. All digital inputs shall be line monitored. Vendor's system shall accommodate both normally open and normally close contacts. Smoke detectors, heat detectors and Manual call Points may be connected in 2-wire collective addressing fire loops.

Each input channel shall be capable of supporting a minimum of ten (10) detectors in a loop. Vendor shall indicate the maximum number of detectors that can be connected on an intrinsically safe and non-intrinsically safe fire loop.




Open and short circuit detection per input channel shall be provided for digital inputs. Modules shall be provided with self-testing facility, to ensure their correct function such as ability to detect logic levels '0' and '1', and also to determine any cross talk between channels.

Vendor's interface shall include circuitry to ensure that any "chatter" or "bounce" encountered during contact closure does not initiate an erroneous alarm.

I/O isolation shall be provided where required, for signal from devices externally powered or which may be subject to high voltages (e.g., AC power).

9.6.4. Relays and Safety Barriers

Where intrinsic safety barriers for specific inputs/outputs are connected to equipment located in a hazardous area, they shall be of the galvanic isolation type. Safety barriers shall be single

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channel. The Vendor shall provide Hazardous area certificates for the complete loop and its components. For all digital outputs interposing relays shall be considered.

Interface safety relays, and I.S. barriers including line monitoring must be in accordance with IEC 61508 SIL 3.

All necessary protection relays shall be provided in the circuits. IS barriers shall be active type and suitable for handling 'smart' transmitter digital communication protocols. Barriers shall be as far as possible single channel type with one input and one output and shall be plug-in modules type mounted on FTAs, within marshalling cabinets.

9.7. Fire Alarm Control Panel

FACP shall be suitable for installation in safe indoor environment (IP-42). FACP shall be equipped with programmable solid stated controller. FACP shall be designed for deriving addressable detectors on the at least four separate loops with more than 64 devices on a loop.

FACP shall be provided with MODBUS RTU for connection to the main control system. The status of each loop and general fault shall be hardwired to FGS.

9.8. Spare Capacity/Expandability




A minimum of 20% installed spare capacity for all types of input/output signals shall be allowed to provide sufficient increase during the detail design phase, and 20% spare space capacity should be allowed for future expansion. This is to include for later addition of new I/O chassis, terminals, etc. as required.

The system shall also be designed such that after commissioning, no more than 70% of the system software (capacity/memory) is utilized.

The system communication networks shall allow an increase of 70% in terms of number of nodes with no noticeable degradation of system performance and access time.

All system internal communication networks shall be adequate to allow for an increase of 30% in the size of the configured database with no noticeable degradation of system performance and access time.

The supplied controllers and associated I/O sub-system shall be sized and supplied with stated spare capacity. All spare capacity of I/O cards for each type of I/O signal shall be installed and wired prior to FAT.

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9.9. FGS Software Functionality

As a minimum, the FGS processors shall provide the following configurable functions:

- Selection: high high (HH), high (H), low (L), low low (LL), average,
- Math computation: add/subtract, multiply/divide, square root,
- I/O: Analog input/output, digital input/output,
- Linearization, square root, threshold, filter,
- Boolean: AND, OR, NAND, NOR, XOR, XNOR
- Miscellaneous: timer, delay counter, sequencer, flip-flip memory,
- Ladder Symbols: NO contact, NC contact, energized/de-energized output, latch/unlatch, on/off delay timer, counter, etc.
- Standard or proven logic module to perform voting system logic such as two out of three etc.

The processors shall be programmed and configured to meet the functional requirements for the project. At start-up, the system shall be immediately and automatically available without human action. The preferred programming method is via function block logic in accordance with IEC 61131.




All system software packages for programming, configuration and maintenance shall be provided. Standard programming method shall be used. Setting of trip alarm levels for analogue inputs, setting of timers, and selection of NO/NC configuration for digital I/O shall be done by software configuration, through a maintenance interface.

Vendor will detail facilities and limitations of the system, to perform simple calculations. Application programs should be structured into well-defined functional modules.

Application programs (software) may initially be stored in RAM memory for system testing, commissioning and plant start-up and shall thereafter be stored either in non-volatile EPROM or volatile RAM/flash EPROM memory.

A software package should be supplied capable of comparing two application software versions and to indicate where the variations have taken place.

All software shall be licensed permanently to the Owner. If any dongle is required these shall be permanent and time unlimited.

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9.9.1. FGS Reset Function

All outputs generated by the FGS processors shall be auto reset – i.e. the output shall return to the non-alarm condition if the initiating device(s) returns to the healthy condition.

Where an executive action is generated by the FGS system output the action shall continue until locally reset at the executive device or system, provided that the FGS initiation has returned to healthy.

Smoke detector loops require a reset facility At the FGS workstation in control room. Other detectors are self-resetting type.

FGS logic reset commands are provided by operator from the PCS, via serial link.

9.10. Communications

A redundant communication link between FGS and PCS shall be provided in order to monitor related events, and to transfer from PCS the commands that are not related to safety, such as test initiation, reset, etc.

Communication to PCS shall be achieved through redundant serial link. Vendor shall provide a MODBUS or proven similar protocol.

Hardwired interconnections shall be provided for interfaces to the ESD system, alarm panel, etc.

The communication interfaces shall have internal and self-diagnostics that ensure data integrity and operational security. Faults and failures of the communication lines shall not degrade the safety system reliability. Recovery of communication shall be automatic.

The Vendor shall provide the complete reference and datasheets of the proposed communication modules at bid stage.




The Vendor shall provide hardware, software and services to ensure that a correct interface is implemented.

9.11. Cabinets and Racks

9.11.1. General

Minimum requirements of the cabinets and panels is detailed in the document “Specification for Panels and Cabinets_BH-17-SM-100-IN-SP-0056”.

The Vendor’s standard system cabinets shall be used.

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All cabinets shall be fully equipped, wired, tested and ready to be installed on site. The Vendor shall also implement the required spare capacity and expandability (20% installed spares with an additional 20% spare space for future expansion).

9.11.2. System Cabinets

System cabinets shall include all equipment required by FGS controller system such as CPU, power supply distribution, controller units, I/O modules, HART/Smart modules including interface with communication cards and power supplies.

Power supply modules, unless integral or part of a rack, shall be located at the top of cabinets. 20% additional installed spare I/O cards for each type shall be provided for future extension. Each I/O rack shall be equipped with redundant integral power supply card, independent from other racks.

System cabinets shall be provided, as a minimum, with alarm outputs for the following:

- Power supply failure,
- Controller failure (watchdog),
- Fan failure, where fans provided,
- High temperature alarm.

9.11.3. Marshalling Cabinets

These cabinets shall perform the marshalling function between:




- Incoming multi-pair cables from the field or control room to be wired on field terminals with disconnect and test facility.
- System cables provided by Vendor to be connected to plug in type connectors within the system cabinets and marshalling racks.

I/O signals shall be grouped based on IS and NIS and the following signal types:

- 4-20mA Analogues
- Discrete (Digital) Signals

Digital inputs and outputs shall be fuse protected if not protected by the system I/O card.

Field terminations shall be rail mounted type.

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Sufficient terminals to accommodate all the cores and screens of incoming and outgoing cables using knife-edge terminals complete with markers shall be provided. All terminals shall be complete with test facility.

IS terminals shall be colored light blue.

Partitions shall be included between terminals for different voltages and when required by the regulations. AC terminals shall be shrouded and flashed accordingly.

Separation between signal and power wiring shall be maintained.

All I.S/N.I.S field cables shall be terminated at terminals. Spare cores shall be terminated at spare terminals (one per core). Galvanic isolators for all spare intrinsically safe I/O shall be provided.

Marshalling cabinets shall be the prime field interface for the FGS.

Marshalling cabinets shall match in construction, dimension and color to systems cabinets containing controllers and I/O cards. (Marshalling terminals could be located in back of the system cabinet if the Number of I/O not to be numerous)

Marshaling facilities (marshalling cabinet) shall be allocated in rear side of the system cabinets.

9.11.4. System Wiring Requirements

Vendor is responsible for the provision of all interconnection cabling and flexible leads to peripherals etc., including cores between marshalling cabinets and system cabinets.




All wiring inside cabinets shall run in dedicated plastic ducts or wire ways, and neatly loomed and secured with tie – wraps and anchors.

All discrete wiring shall be multi stranded with sufficient current carrying capacity. A minimum cross-sectional area of 1 mm² shall be used unless otherwise stated.

Wire ways/ ducting shall be routed to provide sufficient segregation between AC and DC wiring and will be able to accommodate 30% more wiring.

I.S and N.I.S signals shall be totally separated in cables, cable duct, junction boxes, terminal strips, and etc. All FGS system Cables shall be fire resistance according to IEC 60331.

System card bins shall be interconnected with plug and socket type system cables or ribbon type cables and edge connectors. The sockets and both end of the cables shall be labelled with the “Origin” and “Destination” tags.

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9.11.5. Labelling & Tagging

Basically, English language shall be used for labels. Panels and Cabinets shall be provided with nameplates made of multi-layer plastic engraved with the identification number and name in black letter on white background according to the project numbering procedure.

Instruments, terminal boards, fuse/switches and circuit breakers, etc. mounted in cabinet shall be provided with nameplates of multi-layer plastic or equivalent stating the tag numbers, etc.

Terminals shall be clearly and permanently marked according to the data in the related connection list.

All wiring terminations shall be clearly marked using a white plastic slip-on embossed tube with black letters stamped on or other method.

Warning label for power supply terminals and also high voltage terminal (if any) shall be clearly and permanently marked according to the data in the related connection list.

All inter-panel cabling/wiring shall be marked so that source and destination can be identified.

9.11.6. Grounding

The cabinets and panels shall be provided with the following earth bars:




- Safety earth bar (For electrical supplies, bond to metallic frames of cabinets and panels)
- Instrument earth bar (for earthing field cable screens in accordance with N.I.S device requirements)
- Intrinsic safety earth bar (for earthing I.S cable screens and barriers)

A tinned copper safety earth bus bar shall be mounted inside the cabinet or panel and connected to the frames. Separate tinned copper ground bus bars shall be provided with clear demarcation in each cabinet or panel for instrument earth and I.S earth. Instrument earth bus bar and IS earth bus bar shall be isolated from each other and from the safety earth.

All metal parts of the equipment not associated with the circuits shall be bonded to the main chassis.

Serrated washers shall be used to ensure electrical contact between metal parts.

Doors and other removable parts shall be bonded using flexible braided earth straps, suitably sleeved for protection.

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The earthing system shall be organized into separate circuits, as required for protection and for reference. The circuits shall be completely independent. Vendor shall detail the requirements of the earthing system (power, signals, shields, etc.).

10. INSPECTION AND TESTING

In addition to the quality assurance requirements referred to in this specification, the following shall also be complied with:

- All detector and controllers shall be inspected and tested by the Vendor in accordance with relevant standards/ specifications as a minimum.
- All tests and corrective work shall be recorded to the Owner's approval.
- The panel Vendor shall ensure that all inspection and tests are completed and satisfactory.
- The Owner reserves the right to any additional inspection work if Vendor's preparations are found to be unsatisfactory.




This specification is concerned with final inspection and testing of equipment prior to dispatch. Preliminary inspection e.g. to examine cabinets or consoles during or on completion of fabrication will be performed as necessary and recorded separately.

Vendor shall not offer the equipment for testing until he has carried out his own shop tests to the latest approved drawings and documents and has ensured that the equipment is functioning satisfactorily and is complete in all respects. Certificates and completed test dossiers shall be available as evidence of this work.

Following the Vendor's preliminary Factory Acceptance Tests (FAT), the Vendor shall demonstrate that the equipment fully meets all requisition requirements in accordance with the requirements of this specification, related and referenced documents. Owner / Owner's inspector(s) will be present throughout the demonstration, and deviations from this specification may occur only with the Owner's agreement. Such deviations shall be recorded.

For the demonstration, Vendor shall provide:

- Two complete sets of the latest reviewed drawings, specifications and data sheets for the system(s), and operation / maintenance procedures,
- All necessary personnel with relevant equipment to perform the tests,
- A test plan, procedure and test record dossier for all tests to be carried out.

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Faults discovered during inspection and testing shall be rectified as work proceeds and all previously tested circuits affected by the repair work shall be retested. Vendor shall mark up and retain one set of drawings and data sheet for the subsequent production of AS-BUILT information.

The equipment shall be tested as a fully assembled package complete with all cabinets, electronic modules, operator stations, etc, and complete with all cord sets and interconnections.

Where an assembly or circuit is incomplete for any reason or where temporary wiring is installed, then the inspector's agreement must be obtained, and details shall be recorded.




A report and completed test dossier shall be produced by the inspector on completion of all inspection and testing, or at intervals as testing proceeds. A release certificate will be issued by the inspector when all testing has been completed to his satisfaction, and equipment may then be dispatched to site.

10.1. Inspection

All individual items of equipment and the completed system shall be subject to shop inspection by the Owner.

The offered system shall be visually inspected to ensure that it has been constructed to the specifications, data sheets and to the approved drawings. This shall include but not be restricted to the following:

- Use of instruments and components previously approved by the Owner.
- Standard of components and assemblies finishing.
- Overall dimensions, fixing points, and lifting points to approved drawings.
- Frameworks sufficiently rigid to support equipment without distortion.
- Individual instruments accessible for adjustment and /or maintenance without removal of wiring, supports and other instruments.
- Heat generation equipment suitably located with provision for cooling, if necessary.
- Tags, nameplates and warning labels provided as per specifications.
- Terminals and wiring segregated and protected and secured to meet hazardous area and electrical safety requirements.

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- Wiring and trucking to be sized colored and identified in accordance with codes and specification.
- Adequate space allocated for future additions and changes, as specified in the technical documentation.
- Earthing, both for instrument and electrical purposes according to Vendor's agreed standard, if any, and with Owner's specification requirements.
- Identification of fuse holder with the fuse rating and service, and examination of fuses and isolating to ensure that they are connected to the correct circuits.
- Checking of circuits for the correct polarity.

10.2. FAT/SAT Testing




Owner's Factory/Site Acceptance Test (FAT/SAT) shall include but not be limited to :

- Visual inspection
- Elevated temperature tests
- Hardware testing
- Functional testing
- Integrated test (including software, hardware and detectors)

Vendor shall formally submit an Owner's Factory/Site test procedure for the acceptance tests to Owner for review at last 4 weeks prior to presenting the system for test. The content of this procedure shall be discussed in detail with Owner prior to formal submission.

These test procedures shall satisfy the requirements of relevant standards for instruments panels as a minimum and shall include but not be limited to the following items:

- All panel wiring including system interconnection wiring shall be tested for insulation and the test voltage shall be compatible with the wiring being tested (equipment likely to be damaged shall be disconnected for these tests).
- All panel wiring shall be tested for continuity against Owner approved wiring diagrams.
- All equipment shall be tested for electromagnetic interference according to BS 6667 part 3 to show immunity or degradation of normal operation from EMI.
- Wiring identification for all panels.

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- Full simulated function tests of the complete unit with all equipment in position and connected to suitable temporary supplies. These tests must be performed at the maximum operating voltage limits and at the limits of ambient temperature. The Vendor shall provide the test simulator consisting of dedicated devices for every input and dedicate dummy loads with indication of the status of every output. The test simulator shall only be connected to the field connection terminals or systems cable terminations and the input – output interface shall be individually labeled to facilitate testing. The Vendor shall obtain Owner's approval of supply unit characteristics and simulated input – output interface.

If a component failure occurs, all tests shall be repeated so that all components have undergone the minimum testing specified.

During the functional tests, all equipment shall be powered up and shall remain powered throughout the test period. Test equipment shall be connected at field terminals only and not at any intermediate point, with the objective of testing the complete system, or system loops, as it will be installed. If termination and marshalling racks have been shipped in advance, testing shall be from the test panel.

For circuits with milliamp input or output circuits, resistors shall be introduced at the field terminals to simulate field devices, and the resistance varied up to the maximum permitted by the manufacturer's specification.




Alarm circuits shall be checked by open circuiting inputs at the field termination rack or test panel.

Alarms shall be tested to verify that:

- The correct alarm display operates on all appropriate pages.
- There is no interaction with any other non-associated circuit.
- The alarm sequence is correct.
- The alarm suppression facilities are correctly implemented.
- Logging facilities at display and printer are in the correct format and resolution.

Where alarms are derived from an analogue signal within the PLC, the alarm operation shall be verified by varying the signal input.

Alarms and displays shall be fully checked. All equipment failure modes e.g., failure safety, power supply disconnection, etc. shall be checked.

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The completed system shall be tested at three stages:

- Board and assembly level checks in accordance with the Vendor's QA/QC plans and procedures.
- Vendor's factory acceptance tests (FAT) on the completed system.
- Owner's factory/site acceptance tests (SAT) of the completed system. Provision shall be made for the Owner's attendance in SAT.

Communication link between Process Control System and FGS shall be tested during Owner's factory acceptance tests at Process Control System Vendor factory with FGS simulator system. Necessary coordination and providing the simulator at Process Control System Vendor factory shall be considered by Vendor.




This specification relates only to Owner's factory acceptance tests (3rd stage), but test procedures and certificates of conformity for 1st and 2nd stage tests shall be submitted to Owner's inspectors to verify that Vendor's own QA plans and procedures have been implemented at all phases of system assembly. Such procedures and certificates shall be available to Owner's representatives at the time of commencement of Owner's factory acceptance tests. Final acceptance testing shall however take place when installed and connected to ensure compliance with, but not restricted to the scope and requirements of relevant standards/specifications.

11. PREPARATION FOR SHIPMENT

The Vendor and any sub-Vendor shall comply with the preservation and packing specification and the marking. Documentation and dispatch instructions shall be provided after satisfactory completion of all tests and inspections.

The Vendor shall take all precautions deemed necessary for protection during shipment and additionally during storage in a marine environment including the following:

- A desiccant shall be provided inside all enclosures to prevent damage by high humidity.
- The Vendor shall supply a recommended procedure for long term storage (up to 12 months) with the quotation.
- Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during shipment.

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- Each individual carton or box shall be marked with the instrument tag number on the top and side of the carton.



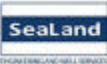

Vendor shall submit the packing specification and the Owner's prior approval.

No items of equipment shall be shipped without the Owner's prior approval.

12. VENDOR DOCUMENTATION

Vendor shall prepare and supply the following technical documentation:

- Bill of materials including quantity and manufacturer,
- System Architecture schematic with all subsystems and peripherals (including room and building locations),
- Functional Design Specification. FDS sections and layout shall be agreed with Owner,
- Block diagram of the system with all cabinets and peripherals showing the interconnecting cables and room/building locations,
- Overall dimensional drawing of each equipment, indicating cabinets, VDU, printer, etc.
- Equipment fixing details showing weights, shock loading, minimum clearance to other items of equipment and wall,
- System cable list/ schedule (including gland size),
- Drawings for relevant cable interconnections between Vendor's equipment (and if necessary other equipment) showing all necessary terminal/pin and wire identification references for onsite connection,
- Layout of FGS matrix panel
- I/O schedule in a format to be decided during detail design. Cross Wiring Schedule from field terminals to I/O cards,
- System power consumption,
- Power distribution diagrams,
- Documentation required from authorities to obtain export licenses to destination country,
- Reference manuals of all software packages and hardware modules,
- User and maintenance manuals of configuration tools,

	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								  
	Specification for Fire & Gas System								
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- System programming details,
- System configuration (including redundancy of components and interfaces to other equipment and systems),
- Performance calculations,
- Availability/reliability analysis,
- Instrumentation loop diagram for all equipment in Vendor's scope,
- Color hard copy for all the custom graphic displays,
- Serial data exchanged with external systems,
- Installation recommendation – documents to take into consideration local conditions,
- Operating and maintenance system manuals,
- Susceptibility of RFI and EMI,
- Acceptance test procedures (FAT, SAT),
- Spare Parts list (including parts for Commissioning/Start-up and two years operation and Consumables),
- All relevant and necessary certification i.e., hazardous area/IS certificates,
- Application software details,
- As-built drawings after commissioning,