

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 1 of 34

Specification for Control System

AFC

APPROVED FOR CONSTRUCTION

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NISOC Ref. Letter: 01/2294/135265

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- 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
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- AB-R: As-Built for COMPANY Review
- AB-A: As-Built –Approved

Page 2 of 34

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 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 3 of 34

Table of Contents

1. Introduction	5
2. Scope	5
3. Definitions	6
4. Environmental Conditions	6
4.1. Site Condition	6
4.2. Tropicalization	6
4.3. Ingress Protection	7
5. Conflicts and Deviations	7
6. References	7
6.1. Project Documents	7
6.2. References Standards	7
7. Basic Principles	10
7.1. Acronyms and Abbreviation	10
7.2. Units of Measurement	12
8. Control System Criteria	12
8.1. General	12
8.2. OWS & EWS	13
8.3. Control System Requirements	14
8.4. Connection with Existing Control System	14
9. Technical Requirements	15
9.1. System Basis Design	15
9.2. System Availability and Reliability	16
9.2.1. Maintainability	16
9.3. System Loading	17
9.4. System Hardware Requirements	17
9.4.1. General	17
9.4.2. Controller	18
9.4.2.1. General	18
9.4.2.2. System Expansion	18
9.4.2.3. Card Positioning	19
9.4.2.4. Rack Arrangement	19
9.4.2.5. Mass Memory	19
9.4.3. Electrical Transients and Electromagnetic Interference	20
9.4.4. Processor	20

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 4 of 34

9.4.5.	I/O Interface System	21
9.4.6.	Power Supply	22
9.5.	Software	22
9.5.1.	Basic Software or Programming Software	23
9.5.2.	Diagnostic to IPCs	23
9.5.3.	Software Language	24
9.5.4.	Software Application	24
9.5.4.1.	Alarms	24
9.5.4.2.	Event List	24
9.5.4.3.	Reports and listings	24
9.6.	Cabinets	25
9.7.	Display	25
9.7.1.	Overview Displays	25
9.7.2.	Individual Loop Displays	25
9.7.3.	Trend Displays	26
9.7.4.	System Status Display	26
9.7.5.	Alarm Summary Display	27
9.7.6.	Group Display	27
9.8.	Alarm Management	28
9.8.1.	General	28
9.8.2.	Alarm Types	28
9.8.3.	Alarm Identification and Acknowledgement	28
9.8.4.	Alarm Messages	28
9.8.5.	Alarm Logging	28
9.8.6.	Strip Chart Recorder	28
9.8.7.	Print-Out Capabilities	29
10.	Engineering Tools	29
11.	Test & Inspection	30
11.1.	Factory Acceptance Test (FAT)	31
11.2.	Site Acceptance Test (SAT)	32
12.	Training	32
13.	Spare Parts	33
13.1.	Construction, Pre-Commissioning and Commissioning Spare Parts	33
13.2.	Spare Parts for Two Years of Operation	33
14.	Documentation	34

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 5 of 34

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:



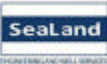

- 1) Revamping of Production and Desalting Units of Bibi Hakimeh 1&2
- 2) Fabrication & Installation a Preheater, Stripping Column and Related Equipment for Nargesi Production Unit

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 Process Control System (PCS) 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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	Specification for Control System								 TR Consulting Engineers	
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 6 of 34	

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.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 7 of 34

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.



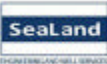

6. REFERENCES

6.1. Project Documents

Instrument & Control/Safety System Design Criteria_BH-17-SM-100-IN-DC-0052
General Specification for Instrumentation_BH-17-SM-100-IN-SP-0053
Specification for Emergency Shutdown System_BH-17-SM-100-IN-SP-0058
Specification for Instrument and Control of Package Unit System_BH-17-SM-100-IN-SP-0055
Specification for Panels and Cabinets_BH-17-SM-100-IN-SP-0056
Specification for Fire & Gas System_BH-17-SM-100-IN-SP-0059
Specification for Burner Management System_BH-17-SM-100-IN-SP-1275
Instrument Earthing Typical Diagram_ BH-17-SM-100-IN-DG-0063
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
Process Design Basis for Nargesi_BH-18-SM-100-PR-DB-0002
Piping and Instrumentation Diagrams (for All the Units)

6.2. References Standards

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

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								  
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 8 of 34

IPS Standards




E-IN-190	Engineering Standard for Transmission Systems
M-IN-250	Materials and Equipment Standard for Process Control System (PCS)
G-IN-220	Engineering and Installation Standard for Control Centers
G-IN-250	Engineering & Construction Standard for Process Control System (PCS)
G-IN-290	Engineering & Construction Standard for Programmable Logic Controllers (PLS)
M-IN-220	Material and Equipment Standard for Control Panels and System Cabinets
M-IN-290	Material and Equipment Standard for PLC
E-EL-110	Hazardous Area

API Standards

RP 552	Transmission Systems
RP 554	Process Instrumentation and Control

BS Standards

381C	Specification for Colors for Identification Coding and Special Purposes
4683	Electrical Apparatus for Explosive Atmospheres
6667	Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment
7671	Requirements Of Electrical Installations, IEE Wiring Regulations

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 9 of 34

EN Standards




50014	Electrical Apparatus for Potentially Explosive Atmosphere, General Requirements
50018	Electrical Apparatus for Potentially Explosive Atmospheres. Flameproof Enclosure 'd'
50020	Electrical Apparatus for Potentially Explosive Atmospheres. Intrinsic Safety 'i'
60529	Degrees of Protection Provided by Enclosures (IP Code)

IEC Standards

60331	Tests for Electric Cables under Fire Conditions
60332	Tests on Electric and Optical Fiber Cables under Fire Conditions
60801	EMI and RFI Immunity
60079	Electrical Apparatus for Explosive Gas Atmospheres
60529	Degree of ingress protection
61508	Functional Safety of Electrical/Electronic/Programmable Electronic Safety Related Systems
61131	Programmable Controllers

IEEE Standards

487	Recommended Practice for The Protection of Wire-Line Communication Facilities Serving Electric Supply Locations
EIA RS 232	Communication Specification

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 10 of 34

ISA Standards





S5.1	Instrumentation Symbols and Identification
S5.2	Binary Logic Diagrams for Process Operations
S5.3	Graphic Symbols for Distributed Control/Shared Display Instrumentation logic and computer systems
S5.4	Instrument Loop Diagrams
S18.1	Annunciators, Sequences and Specification

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

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								  
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 11 of 34

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
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

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								  
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 12 of 34

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
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. CONTROL SYSTEM CRITERIA

8.1. General

The control (PLC) System consists of parts in the following:

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 13 of 34

- Control system
- Operating system
- Engineering system

EPC Contractor shall design & prepare Control System with high availability (Hardware) for Critical Signals. The new control system shall be redundant in CPU, Power Supply, Communication Module, Ethernet network, and separated from ESD system.

The main control system shall be redundant according with IPS recommendations. The monitoring and diagnostic interface between the operator and the control system shall be through a HMI system, communicating to the PLC though an Industrial Ethernet network.




A control system shall be used for process control and to provide operator with the ability to perform all control and monitoring functions. This approach allows all process measurements and alarm/status inputs to be wired to control and data acquisition devices.

Each control system shall provide the following functionality as a minimum:

- Graphic Displays at both overview and detailed levels.
- Alarm listing displays.
- Loop configuration displays.
- Displays for special signals groupings
- Current and historical trend displays.
- Alarm & event logging.
- Data storage and archiving.
- Report generation.
- Hard copying (screen prints, paper reports).

8.2. OWS & EWS

Each Operator workstation and engineering workstation with all of the accessories such as industrial personal computers (IPC) shall be connected to a redundant Ethernet network.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 14 of 34

8.3. Control System Requirements

New control system will be capable to diagnosing, enough monitoring for operator to efficient directing, estimating fault time, maintenance programming for reducing unexpected interrupts accordance with preventing maintenance and predicting maintenance. The new control system shall be designed to cover all new requirements with latest proven Technology.

Control system shall have engineering/operating workstation with entirely industrial hardware e.g. industrial monitor, LCD at least 21" for desktop PC, Keyboard, and trackball Mouse. OWS shall have industrial dual monitor stand arms.

One industrial laptop set with "connect to industrial network" capabilities and programs which certificated by the PLC's manufacture, will be meet. Also, on the laptop shall be installed all of the required relevant software.

The system will be capable to operate online changing on the controllers and I/O cards without needing the interrupts. Particularly it will be provided online and remote changing operations without any interrupt.

The system shall be capable to store necessary data for at least one-year period.

Using software shall be permanent license and have capable of simulation, software shall be of the latest proven version also engineering, configuration, documentation, and diagnosing of software shall be online.




In the new monitoring systems shall be considered events and trace diagrams analyzing and reporting, data logging, meanwhile shall be operated to indicate and register alarms and event, likewise save them.

The Contractor shall be considered assembling and configuration of the suggested systems when prepared specifications and other documents.

8.4. Connection with Existing Control System

Required signal transferring between new PCS and existing control system will be carried out in accordance with the process requirement as will be specified and finalized in the P&IDs.

Basis of the new PCS and existing control system will be specified in the documents "Control / ESD / F&G System Overall Block Diagram for Bibi Hakimeh Production Unit No.1_ BH-17-SM-100-IN-BD-0274", "Control / ESD / F&G System Overall Block Diagram for Bibi Hakimeh No.2_ BH-17-SM-100-IN-BD-0706-D00" and "Control / ESD / F&G System Overall Block Diagram for Nargesi_ BH-18-SM-100-IN-BD-0119-D00".

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 15 of 34

9. TECHNICAL REQUIREMENTS

9.1. System Basis Design

PLC system will be Redundant with the following requirements:

- Redundant CPU.
- Redundant I/O bus.
- Redundant power supplies.
- Redundant industrial network

The PLC system shall interface directly with the following devices, but not limited to:

Inputs:




- Analogue transmitter
- Field contacts
- Pushbuttons/key switches
- Trip contacts from switchgear, if necessary, on the basis of Electrical requirements
- F&G system, if necessary, on the basis of Process and Safety requirements
- Status indicators on the module
- Other subsystems, if necessary

Outputs:

- Solenoid valves
- Analog output (if any)
- Motor Control Center and switchgear devices, if necessary, on the basis of Process and Electrical requirements
- Digital outputs

All I/O signals from and to hazardous area will be provided with suitable Ex protection measures. I/O signals between PLC and IRP to be considered as non-hazardous. It should be mentioned IRP shall be located at MCC Room.

The PLC system will be powered from redundant uninterruptible power supply system (110 VAC, 50 HZ). However, the system shall withstand voltage and frequency variation up to $\pm 10\%$ and $\pm 5\%$ respectively.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 16 of 34

The PLC system will supply and distribute required power.

The system has a modular architecture, which will make it possible to service parts or components without changing the function of the remained part of the system. Software reliability shall be considered in order to reduce effects on the overall system reliability. The electronic parts shall not be susceptible to interfere with hand held radio transceivers in the immediate vicinity, or any other electronic equipment.

Contractor shall ensure that system hardware is suitable to withstand voltage surges. Electrical and electronic instrumentation for installation in hazardous area zones shall be certified in accordance with the definitions given in IEC-60079 “Electrical Apparatus for Explosive Gas Atmospheres” and IPS-E-El-110 “Hazardous Area”.




Solenoid valves which utilized in hazardous areas shall be the explosion proof EEx (d) type. Equipment and cabling in areas which are not protected by either earthed steel structures or dedicated lightning conductors shall be provided with lightning protection. Equipment located outside protected areas and instruments connected to cables that are routed outside protected areas shall be provided with protective lightning arresters at both ends of the transmission line.

9.2. System Availability and Reliability

A system reliability and availability analysis shall be provided for each system unit and the total system quoted by the vendor. The system shall have a high degree for tolerance to malfunctions of hardware. The system shall remain operational but at a reduced level of functionality. Vendor shall specify the source of reliability data used. (Manufacturer’s databases or other available component databases). Vendor shall provide his highest reliability and availability analysis calculation for the configuration proposed using a recognized methodology and internationally accepted component reliability figures.

9.2.1. Maintainability

PLC system shall be designed in order to minimize and reduce spare parts quantity and training for operator / maintenance technicians. It shall incorporate a comprehensive set of diagnostic features including history logging, alarming and reporting facilities. Log time and date stamping will be implemented at the PLC level.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 17 of 34

9.3. System Loading

System hardware and software shall be modular and the system shall be designed with flexibility for future expansion. This expansion shall be achieved by straight addition, not modification of hardware and with a minimum of software and configuration changes.

This spare shall be spread uniformly throughout the system, over the various plant sections.

- The internal memory shall be sized such that at least 50% spare memory is available after definition of the I/O tables and entry of the application program (IPS-M-IN-290).
- In addition, 20% free space shall also be considered for cabinets (IPS-M-IN-220).
- The vendor shall include in his scope of supply the spare parts and consumables for erection, testing, pre-commissioning and start-up.
- The vendor shall provide in his quotation, the price of recommended spares for 2 years operation.
- Each functional I/O rack shall have a 20% spare I/O installed and wired.

The above loading figures shall apply to the fully configured system, comprehensive of spare and uninstalled interfaces.




9.4. System Hardware Requirements

9.4.1. General

The hardware is included in cabinets, completely wired & connected to plug sockets and including:

- Safe relays for outputs to solenoid valves & motors (testable).
- I/O cards for analogue and digital signals
- CPUs.
- Interface modules.
- Power supplies.
- Displays
- Alarm Managements
- Barrier

It should be mentioned Analog and digital cards shall be maximum 8 channels and 16 channels

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 18 of 34

respectively. In addition, Hart Protocol shall be supported by Analog cards.

System cables belong also to the delivery of the PLC manufacturer.

The system shall be modular and industrial controllers in standard 19" rack according to ANSI/EIA 310 and IPS-M-IN-290 (4.1.1) standard. The PLC vendor shall provide the following diagnostic programs on his proposed system:

- Self-checking diagnostic on initialization (Start-up)
- User-initiated diagnostics
- Program memory integrity check

9.4.2. Controller

9.4.2.1. General

Vendor shall offer its standard process controller equipment to meet the controller and input/output requirements described below.

Process controllers shall work independent from communication system. Loss of communication over the data communication link shall not affect regulatory control performance. Process controllers shall continue to operate if communication with the operator console is lost.





A redundant serial link shall be provided to connect PCS and ESD/FGS. All tags and alarms shall be available in PCS. This serial interface shall be used MODBUS RTU protocol with redundant configuration and hardware dongle.

The process controller equipment shall be located in the Control room of the central control building. The different interfaces for data exchange with field equipment like sensors, valves etc. should be suitable to locate them in hazardous area.

9.4.2.2. System Expansion

The system shall be capable of expansion by straight hardware addition without modification of the proposed hardware. Equipment shall be of modular construction with maximum interchangeability between modules. Related system software shall also be capable of modular expansion.

The installed software shall make it possible to extend the controller and calculation facilities (by configuration only).

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 ساجي SAGI  SEALAND OILFIELD SERVICES  TR Consulting Engineers
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 19 of 34

9.4.2.3. Card Positioning

Input and output cards shall be separated in such a manner, that cards having similar functions are grouped together with high- and low-level signals, separated as far as possible, in order to minimize noise pickup.

9.4.2.4. Rack Arrangement

Card racks, should be mounted with the card in the vertical plane.

The processors shall be mechanically and electrically isolated. Each processor shall provide protection against overload current and line voltage spikes. The main controller shall be unaffected by failure of other devices connected by communication. Remote I/O arrangement also is acceptable, if necessary. For signal communication inside control room building wiring between input or output terminals and PLC racks shall be run in plastic raceways, physically separated from the logic wiring. Where different voltage levels exist between groups of inputs or outputs, these shall also be segregated.

For field input / output signals, it shall be possible to install the interface equipment in hazardous area.




The following signal types shall be possible to connect to field-interfaces:

- 4-20 mA sensors, actuators
- digital sensors, actuators
- others

9.4.2.5. Mass Memory

The redundant system mass memory (hard mirroring disc with two independent drivers) shall hold of all system and application software and data base, as well as loading of all events and alarms required for historic purpose. Information from any device and module can be stored in the mass memory and be used for the following purpose:

- Continuous process history,
- Reports and logging history,
- Storage of all reports and logging formats,
- Storage of all custom displays,

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 20 of 34

- Storage of the totality of database and configuration/program parameters.

9.4.3. Electrical Transients and Electromagnetic Interference

PLC shall be immune to signal strength of 10 volts/m with the panel door open and 15 volts/m with the door closed, over a frequency range of 20MHz through 1 GHz at 1-meter distance.

The PLC shall be supplied with provision for protection against system error and hardware damage resulting from electrical transients on power or signal. These transients include those generated by switching large electrical loads, by power line fault due to lightning strikes and lightning surges on power or signal cables.

9.4.4. Processor

The processors are in charge of all PLC sequences and test facilities. They shall be operating synchronously and in parallel. Each processor shall consist of microprocessor, memory, test circuits (if any) and necessary communication blocks.

The system-operating program shall be resident on flash ram memory. The central processing unit should contain the application program in non-volatile memory.




If the application program is kept in a battery backed up memory, then:

- It shall be possible to replace the battery while the system is operating without losing the contents of the memory.
- Indication of low battery power shall be provided locally by LED and remote on system status display.

The CPU shall continuously scan the control program stored in memory, along with the status of all inputs and execute specified commands to appropriate outputs. Each processor shall provide sufficient memory for the initial configuration plus 40% spare capacity for future expansion. Every PLC shall be supplied with batteries used for maintaining.

The processor shall have preferably, the following types of memory:

- Executive Memory (ROM type)
- Internal RAM (Processor's Scratch Pad Memory)
- I/O Image Memory.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 21 of 34

9.4.5. I/O Interface System

All field instruments and equipment external to the PLC shall terminate in terminal strips located in marshalling.

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

The I/O interface shall be of bus-oriented system preferably. Serial I/O system shall be employed for remote I/O. Application of parallel I/O system shall be limited to local I/Os housed inside the same enclosure as the processor module. There shall be no need to disconnect the power to the faulty or other modules for removing and/or replacing the modules.

All I/O modules shall be capable to operate in the project environmental conditions.

Input section shall be designed to receive input signals from field contacts and field transmitters. Input circuits shall be type-tested for surge withstanding capability. Output circuits shall be provided with protection against the switching of inductive loads (i.e. solenoid valve coils) and protection against current overloads. The I/O interface system shall connect all fields wiring signals to the PLC system and shall perform signal conversion, signal conditioning, and signal multiplexing features. All I/O signals from and to hazardous areas shall be provided with suitable Ex. protection measures.

The I/O interface shall comply with the following requirements:

- The number of different types of I/O units should be minimized.
- The I/O cards will be replaceable with the system energized (on-line) without affecting the function of the reminder of the system.
- Indication shall be provided (by LED) on each module to show module status and power. Also, other LEDs should be considered for each I/O channel.




Inputs & Outputs

The quantity of I/O Signals with PLC Functions will be shown in detail design documents.

Signals to/from MCC and Package PLC (if any) will be general purpose design and free voltage contact.

RTD signals for control function will be converted into 4-20 mA signal by locally head mounted temperature transmitter.

All Analogue I/O signals, from and to field instruments will be intrinsically safe and all field Switches shall be explosion proof; exceptions require Owner's approval case by case.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 22 of 34

9.4.6. Power Supply

System power supplies shall have galvanic isolation between input and output voltage, over voltage protection, current limiting. A dedicated power supply unit, included in the scope of supply, shall be used to feed power to racks of the system.

Vendor shall carry out a fuse coordination study to ensure that in case of a short circuit only the directly protecting fuse or circuit breaker interrupts the circuit and no higher-level fuse melts or circuit breaker opens. If the Vendor requirements require dedicated grounds, the proposal shall include sufficient information to determine how these grounds are to be arranged.

Vendor has to provide all the equipment necessary to generate the different voltage levels needed by the PLC system. These power and distribution systems shall be fully redundant that switching between the main and stand-by modules be possible in case of failure of one of them, in such a way that the whole system continues to operate without any interrupt in normal function.

Vendor shall indicate the consumption of the system (auxiliary and control room) as well as the heat dissipation for each cabinet and engineering console. Power supply unit status shall be indicated on its faceplate and shall be remotely communicated via alarm contacts and software. The system shall be designed to ensure that no incorrect command is given to the field devices upon power on or power restore to the CPU or I/O modules.

9.5. Software




The programming software shall be provided on the workstation and shall be menu driven, Fill-In-The-Blanks configuration, preferably, in an easy-to-use manner for programming, documenting, and printing programs on-line.

The program shall be Microsoft Windows compatible and shall include a universal programming interface to the PLC processor.

The program shall create, edit, and monitor any user program.

The workstation shall receive data table information once every control program cycle to ensure faults are detected quickly.

The software shall be capable of alarm handling according to the user defined arrangement. The alarm handling shall automatically signal the operator through a dedicated screen window on the display. Alarms shall also be recorded in an alarm summary page.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 23 of 34

The software shall provide printing and archiving facilities for all alarms and operator commands. All software supplied shall be original manufacture, and provided with certificates of authenticity.

9.5.1. Basic Software or Programming Software

For development, commissioning and maintenance purpose the basic software shall provide the following functionalities:




- Off line mode, which shall give the possibility to create or modify an application program without connecting the CPU,
- On line mode, which shall:
 - give the possibility to make program change while the CPU is running,
 - Allow saving functions (parameters, application programs, etc.)
 - be used, for commissioning phase, and maintenance purpose
- On line monitoring mode, which shall give only the possibility to read out all the PLC Inputs, outputs, variables, etc.

9.5.2. Diagnostic to IPCs

PLC diagnostic information required for the application will be defined during detailed engineering.

The following diagnostic information shall be transmitted to the IPCs as a minimum:

- System fault/ alarms.
- All cards' fault/alarms
- Internal power supplies failure.
- Battery backup alarm.
- Memory fault alarm
- Specific I/O alarm
- Redundant module alarm
- Communication loss alarm
- Control System connection fault alarm

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 24 of 34

9.5.3. Software Language

The following programming instructions shall be available as a minimum:

- Arithmetic functions,
- Logic operators (And, Or, Latch, etc.)
- Specific Function blocks (PID, Counters, Timers, etc.)

Programming language shall be based on Boolean, Ladder or Logic-block. The programming language shall be able to support textual descriptions, in order to permit to define clearly all functions (I/O, internal variable, etc.).

9.5.4. Software Application

9.5.4.1. Alarms

When PLC Alarms management system is required for the application, it will be defined in Package call for bid.

When required, the minimum facilities provided shall be:




- Three alarm levels of alarm priority shall be distinguished as a minimum,
- Alarm masking facilities shall be provided with specific access levels for start-up and maintenance.
- Alarm logging,
- First-up alarm identification and acknowledgment.

9.5.4.2. Event List

A documentary list which presents all discrete events within the system, indicating the time and description of the events. The time stamp resolution of the events shall be less than 100 m Sec. The alarm messages shall be user definable and the length of them shall be minimally 80 characters. The system shall support 10 separate lists minimally.

9.5.4.3. Reports and listings

The HMI shall provide suitable means to document the reports and alarm listings with presentation of the time of occurrence of each item and pertinent designation of sequential events and operator entries.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 25 of 34

9.6. Cabinets

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

9.7. Display

Any operator station shall be capable of providing display for an entire plant or areas of the plant.

The following displays shall be provided.

9.7.1. Overview Displays

Overview display shall enable the operator to monitor the plant overall conditions, major control loops and variables with status identifications by color changing and blinking on the basis of pre-assigned groups.

The overview display shall be divided into groups.

There shall be one or more overview display pages covering all inputs to the system.

At the relevant overview page an operator shall be informed, through colour change, whether an input/ group is in normal or alarm state. Each group and its identification shall relate to a group display.

In case of alarms, location of the instrument /loop in abnormal condition shall be shown to operator via color changes or etc. addition to visual alarm an audible alarm need to be generated in abnormal cases.




9.7.2. Individual Loop Displays

The individual loop display shall present all relevant information and configuration data belong to the loop such as:

- Zero and span of input
- Output limit setting
- Setting of controller and function blocks, i.e. PID values, ratio, bias, gain, reset, etc.
- Alarm set points

These parameters shall be able to change from this display with the security protection.

Individual loop display may include a real time trend display to show process variable and

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 26 of 34

controller output for the purpose of control parameter tuning.

It contains a barograph that displays the set point, process variable and the loop output in the same form as the group display.

9.7.3. Trend Displays

Historical and real time trends shall be displayed as graphics, with one line per variable. A minimum of four (4) variables shall be displayed per trend display, distinguished by different colors (including the indication which variable belongs to which color).

It shall be possible to suppress any single trend in a trend display to enable the analysis of the remaining trend lines.

A marker shall be available to move across the time axis to determine specific values of data at the selected time. The data at the selected time shall be shown numerically and in engineering units. It shall also be possible scroll horizontally through the historical trends on the screen. Dedicate keys shall be available to move through time and arrive to desired time.

The timescale resolution will be configurable (10 steps) by operator from 2 seconds up to 60 minutes per point to view the entire recording period (historical, archival). The physical scale shall have the possibility of an automatic adjustment to the minimum and maximum of the physical values displayed.





It is required that the system allows historic and real time trending of binary inputs and outputs on same trend displays as analogue values.

Trend displays of 20 minutes, 1 hr and 3 hr or similar periods shall be provided. A 24 hr trend shall also be provided. Historical trends and data from fixed and removable storage shall be provided for late play-back as an aid analyzing process upsets and performance.

The system shall have the capability to trend a minimum of 400 data points, for at least 48 hr with an average sample interval of 2 minute without changing removable storage media. Real time trend facilities for controller tuning are preferred (maximum sample time for process variable, manipulated variable and set point: (ten seconds).

9.7.4. System Status Display

The system status display shall monitor all devices attached to the communication system. All failures shall be shown and initiate an alarm.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								  
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 27 of 34

The status display shall list all devices with their location and status. Only system alarms may be acknowledged from this display including fault coming from power supply subsystems.

System diagnostic alarms for any device failure shall appear on a priority basis on the operator console irrespective of display selected. Access to detailed system diagnostic display shall be restricted via security key lock or software password from Engineer console.

9.7.5. Alarm Summary Display

The alarm summary display shall contain all existing alarms with date and time of occurrence. The alarm “Sort” facilities by:

- Process system or group,
- Time of occurrence,
- Major equipment,
- Shift,

Above mentioned cases shall be considered as an interesting capability of the system. System and process alarms shall not be lost in the event that the alarm summary buffer becomes filled with alarms and subsequent alarms occur. (The alarms will be stored in a FIFO memory containing at least 1000 alarms considering nevertheless that system and process alarms shall not be lost in the event that alarm summary buffer over flows and new alarms occur.)

9.7.6. Group Display

The group display shall indicate the status of control loops and process variables, which are pre assigned in a group. Each group shall contain up to eight tags at least.




Group display shall indicate numerical values of process variables, controller set points, controller output and alarm set points with engineering unit.

Each group display shall show process variables and output as barographs. A loop or variable shall be able to appear in any number of groups.

Each loop or variable shall be identified by short tag and service description.

Manipulation of controller output, changing of contact output, set point and controller mode (auto/manual) change and output (in manual mode only) can be possible from the group display. Valves can be opened and/or closed from the group display.

Also, from group display it's possible that an operator selects a single loop to access to the loop display.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 28 of 34

9.8. Alarm Management

9.8.1. General

Any operator interface shall be selectable for alarm service at all time. The alarms should be automatically presented in chronological order and have a buffer of 200 alarms operating on a first in first out basis. Conventional annunciators will be dedicated to emergency shutdown system and critical alarms.

9.8.2. Alarm Types

Process alarms are generated by deviations from normal operating conditions or by violation of signal levels configurable in the system or from contacts closures.

9.8.3. Alarm Identification and Acknowledgement

The PLC shall allow quick identification of the priority level of an alarm and a means to easily call up the group, the graphic or the alarm summary display to acknowledge that alarm.

9.8.4. Alarm Messages

The standard operation displays shall provide the user with visual notification of system alarms. The alarm notification time will be 1 second.

The alarm message shall be unique to each loop and shall indicate the type of alarm (tag, description, priority, absolute value high or low, deviation, failure, date and time of occurrence, etc...) group number and mimic number.




9.8.5. Alarm Logging

The control system shall be capable of storing at least a minimum of two hundred alarms if the stream of alarms occurs faster than the printer may function.

If the printer fails, the alarm sequence shall remain in the memory of the PLC system until the printer is returned to operation, or the system is fitted with a backup printer to avoid jamming of the buffer.

9.8.6. Strip Chart Recorder

The operator must have the possibility to select some variables to address them to recorders channels of his choice and start or stop trend recording as required via keyboard.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 29 of 34

9.8.7. Print-Out Capabilities

The operators shall have the capability to print out any display of any console by selecting the graphic printer. On operator demand Sequence of Event (SOE) print outs shall be available with the same sort facilities as display capability.

The alarm printer shall print out all the alarms as soon as they occur, and on operator demand all the operator changes (change of control modes, limits, start/ stop, shut down procedure, alarm acknowledgment and other specific status changes).

Alarm message print-out show as a minimum: tag, description, date and time of occurrence, time of acknowledgement and time of return to normal. Capability to obtain graphic trending (real- time or historical) on the printer shall also be available.

10. ENGINEERING TOOLS




The PLC system Vendor must provide all the software and hardware (engineering tools) necessary to build and modify the configuration of operator stations, and PLC system control units, computers and network interfaces and will clearly identify and describe these tools.

The list of all available hardware and software packages will be provided for appropriate evaluation of the system. All engineering tools must be self-documenting; all required reports prints, drawing, etc. must be issued by the tool to allow engineering and maintenance people to control all the configuration and programming.

The engineering workstation will be installed in the control room and will be provided with the following as a Minimum:

- Display
- Keyboard
- Mouse or trackball
- Mass memory storage (Hard disk)
- CD ROM drive
- The Industrial PC from a well-known brand and latest technology for EWS/OWS
- At Least LCD 21"

The engineering workstation will be provided to allow:

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 30 of 34

- Programming of the system.
- Modification of configuration.
- Validation and download.
- Saving of configuration on external support.
- Bypass of the inputs/outputs for maintenance purposes.
- Testing as required to ensure availability and safety integrity of the system.
- Fault diagnostics.
- Application documentation.
- Simulation and test (facilities shall be provided in workstations).

11. TEST & INSPECTION

Inspection and testing are divided in two main categories which shall be performed by Vendor/Contractor and witnessed by Company's representative. These categories are:

- Factory Acceptance Test (FAT)
- Site Acceptance Test (SAT)




The PLC Vendor shall submit his own test procedures (Factory Acceptance Test) for all hardware, software, and firmware supplied, based on the requirements specified here in. No material or equipment shall be shipped, unless all required tests have been done successfully and certified by the Client assigned inspector.

There are two broad test categories which shall be performed; Functional Test and Structural Test.

Functional Test shall be performed with software under test as a "black box". The test shall contain sets of data (both legal and illegal) and checking of the corresponding outputs.

The Functional Test shall concentrate on the external behavior of the system to detect functions that have not been implemented or does not operate properly. The "Functional Test" procedure shall be submitted by Vendor for final Factory Acceptance Test (FAT).

"Structural Test", on the other hand, is the "white box" tests where detailed knowledge of the structure and coding of software is required. This type of test shall be proposed by Vendor for quality assurance tests.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 31 of 34

11.1. Factory Acceptance Test (FAT)

The FAT shall be performed when the completed system, including all hardware and software components have been assembled and prepared for operation in the factory.

The testing procedure shall be performed with the aid of adequate simulation hardware and software and/or test programs. The objective of the testing procedures is to ensure that all hardware components and the related software modules (standard function blocks) are free from errors/defects when being tested individually and in the system configuration.

The communication between PLC system and ESD and MCC is also to be tested. The test procedure, e.g. simulation of test program, has to be clarified between Contractor and vendor.

The test will be performed with the aid of test programs permitting easy location of defective components and/or software modules.

The system shall be heat soak tested. Test procedure shall be prepared by the vendor for approval.

During the factory acceptance test, the complete system must remain 100% operational for at least 100 consecutive hours with no hardware and/or software failures.




The Vendor shall provide test and simulation equipment required to perform the test in an efficient and timely acceptable manner.

The manufacturer shall keep simulation equipment for simultaneous testing of 100% of I/O-signals available (with multiple Plug-in connectors). Contractor and the vendor shall agree upon the start of the test. If any failures occur within the said 100 hours the test shall be restarted when the failure has been corrected and the system shall be retested for another 100 consecutive hours.

The test procedure (e.g. simulation or test program) has to be clarified between Contractor and vendor. Contractor reserve the rights to modify the Vendor's standard testing procedures.

Vendor shall formally submit a FAT procedure to Client at least 6 weeks prior to presenting the system for test in accordance with project requirements. The content of this procedure shall be discussed to approve in detail with Client prior to formal submission.

During FAT, Contractor shall prepare a report signed by Contractor and the vendor. After the Factory Acceptance Test has been successfully completed the system shall be ready for shipment to plant site.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 32 of 34

11.2. Site Acceptance Test (SAT)

After transportation to plant site the vendor has to investigate and prove all system components and devices against transportation and erection damages.

Prior to plant start up the SAT shall be carried out after completion of system, cables and field instrument installation. The system shall be tested by site Contractor under the supervision of PLC system vendor.

Vendor shall submit the test procedure for Contractor / owner approval.

This level of testing will take place on site after the system has been installed and certified as operational by the Vendor.

The Vendor shall have the responsibility to ensure that the installed hardware including the software supplied is fully operational.

The testing procedure shall include mechanical checks of the system including all system links connected according to the Vendor's specification.

After this the software will be loaded and self-test routings of the PLC system shall ensure that all system components are in acceptable condition as well as the communication links are working properly.

The application software will be loaded. If the system shows no deviation to the normal operation, the system will be ready for loop checks.




All guarantee performance data which are specified (CPU spare capacity from the field Control System, spare capacity of Hardware, scanning time of process variables etc.) will be proven by Contractor.

Certificate of acceptance shall be signed by the representatives of the Contractor and Vendor Both hardware and software shall be prepared to establish an environment equivalent to that encountered in actual use and test shall involve both process equipment and the control system.

The Site Acceptance Test is functional test and may be carried out in stages with procedures similar to the factory Acceptance Test, but, with the actual process input and outputs connected.

12. TRAINING

- Within his offer the Vendor/Supplier shall propose the comprehensive training program for the system.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 33 of 34

- The training courses shall include the following:
 - System's software and configuration training
 - System's hardware and maintenance training
 - Separate training courses shall be arranged for engineering and operator teams. The engineering team training shall be arranged before FAT.
- For each course the Vendor/Supplier shall indicate, as a minimum, the following:
 - Duration
 - Number of persons
 - Place of training
 - Training materials

13. SPARE PARTS




13.1. Construction, Pre-Commissioning and Commissioning Spare Parts

Vendor/Supplier shall recommend the spares for construction, pre-commissioning, commissioning and construction allowance, which will be purchased together with the equipment, and include the cost of spares in the quotation. Also, spare part of control system (CPU, I/O Cards, Power Supply ...) shall be 20% as minimum.

This quotation shall include normal consuming materials and Accessories.

13.2. Spare Parts for Two Years of Operation

- Vendor shall submit the spare part list according to manufacturer code. Mentioned list shall be approved by the Client.
- Vendor/Supplier shall recommend the spares required for 2 years of operation and provide a price list.
- Two years of operational spare parts shall be quoted by vendor/supplier according to vendor/supplier's experience on similar type of plant.
- Two years of spare part of control system (CPU, I/O Card, Power supply ...) shall be provided a number of each equipment by Vendor/Supplier.

 NISOC	Development Plan of 28 Reservoirs / BIBI HAKIMEH Oilfield (EPC)								 
	Specification for Control System								
Contract No.: 053-073-9189	Project BH	Package 17	Contractor SM	Fac. 100	Disc. IN	Doc. Type SP	Ser. No. 0057	Rev. D04	Page 34 of 34

- EPC contractor shall provide the spares listed in vendor/supplier's recommended spare part list after review.
- Validity of spare parts proposal shall be 12 months.

14. DOCUMENTATION

- In event of an order being placed, the number of copies and electronic files of the preliminary documents and drawings to be sent for approval and the final as built document and drawings to be supplied, will be specified in the purchase order
- At least 1 set of electronic files of drawing shall be available at the site when the cabinet or/and control panel arrives
- The documents and drawings which shall be prepared includes but is not restricted to the followings:
 - Outline Drawing showing dimensions in (mm) and mass of cabinets, or/and control panels
 - Installation and Maintenance instruction
 - Description of operation
 - Electricity consumption with all loads energized
 - Schematic wiring and cable construction diagrams of complete system
 - Terminal arrangements
 - Description of test procedures
 - FAT/SAT procedures
 - Earthing arrangement
 - Power distribution with fuse ratings/types
 - Integral wiring diagrams or lists
 - Control System Architect
 - Loop Diagram