

ENGINEERING & CONSTRUCTION STANDARD**FOR****PROCESS CONTROL SYSTEM (PCS)****FIRST EDITION****JANUARY 2014**

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS is based on internationally acceptable standards and includes selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

Standards and Research department

No.17, Street14, North kheradmand

Karimkhan Avenue, Tehran, Iran.

Postal Code- 1585886851

Tel: 021-88810459-60 & 021-66153055

Fax: 021-88810462

Email: Standards@nioc.ir

GENERAL DEFINITIONS:

Throughout this Standard the following definitions shall apply.

COMPANY:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER:

Means the "Company" where this standard is a part of direct purchaser order by the "Company", and the "Contractor" where this Standard is a part of contract documents.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the "Company" rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

This Standard has been prepared in two parts as follow:

Part 1: "Engineering Standard for Process Control System (PCS)"

Part 2: "Construction Standard for Process Control System (PCS)"

PART 1

ENGINEERING STANDARD

FOR

PROCESS CONTROL SYSTEM (PCS)

CONTENTS:

PAGE No.

1. SCOPE 3

2. REFERENCES 3

3. UNITS 4

4. FRONT- END ENGINEERING 4

 4.1 General 4

 4.2 System Configuration Diagram 6

 4.3 Control Philosophy 7

 4.4 DCS Function List 8

 4.5 Process Flow Diagrams and Specifications 8

 4.6 Plot Plans 8

 4.7 Safety Instrumented Systems Reports 8

 4.8 Questionnaire 8

5. ITEMS TO BE CLARIFIED BY PCS VENDOR 8

 5.1 System Capabilities and Redundancy Requirements 8

 5.2 Process Controllers and I/O's 9

 5.3 Networks and Communication Medium 9

 5.4 Work Stations 10

 5.5 Trending 10

 5.6 Interfacing 10

6. SYSTEM DESIGN ENGINEERING AND DOCUMENTATION REQUIREMENTS 11

 6.1 General 11

 6.2 Documents to be Prepared for PCS Configuration(by Vendor with Company Approval) 11

 6.3 Electrical Design Requirements 12

APPENDICES:

APPENDIX A1 15

APPENDIX A2 16

APPENDIX A3 17

APPENDIX A4 18

APPENDIX A5 19

APPENDIX A6 20

APPENDIX B1 21

APPENDIX B2 23

1. SCOPE

This Standard covers the engineering requirements to plan and design the Process Control System (PCS) for Iranian Petroleum Industries.

The engineering activities mentioned hereto refers to those engineering activities, to be performed by the Company/ Consultant engineer, other than the Manufacturer's engineering package. These engineering activities must be performed to communicate the Company's requirements to the Vendor/Supplier for each specific project.

This Standard addresses the processes required to successfully implement Process Control Systems for Petroleum Industries. The major topics addressed are:

- The basic functions that a Process Control System may need to perform, and recommended methodologies for determining the functional and integration requirements for a particular application.
- Project organization, skills and management required to execute a process control project and then to own and operate a Process Control System

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on Nov. 2002. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 173 on Nov. 2002. These modifications are included in the present issue of IPS.

Note 2:

This is a revised version of this standard, which is issued as revision (1)-2014. Revision (0)-1996 of the said standard specification is withdrawn.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

ISA (INTERNATIONAL SOCIETY OF AUTOMATION)

S 5.1	"Instrumentation Symbols and Identification"
S 5.2	"Binary Logic Diagrams for Process Operation"
S 5.3	"Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems"
S 5.4	"Instrument Loop Diagrams"
S 5.5	"Graphic Symbols for Process Displays"
S 50.00.01	"Compatibility Analog Signals for Electronic Industrial Process Instruments"
ANSI/ISA 95.00	"Enterprise-Control System Integration"

IEC (INTERNATIONAL ELECTROTECHNICAL COMMITTEE)

IEC 60863 "Presentation of reliability, maintainability, and availability Predictions"

MIL STD (MILITARY STANDARDS)

MIL-HDBK-217 "Reliability Prediction of Electronic Equipment"

IEEE (INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS)

C 62 "Guides and Standards for Surge Protection"

API (AMERICAN PETROLEUM INSTITUTE)

RP 500 "Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2"

RP 554-1 "Process Control Systems Part 1: Process Control Systems Functions and Functional Specification Development"

RP 554-2 "Process Control Systems Part 2: Process Control System Design"

RP 554-3 "Process Control Systems Part 3: Project Execution and Process Control System Ownership"

ANSI (AMERICAN NATIONAL STANDARD INSTITUTE)

Y 32.11 "Graphical Symbols for Process Flow Diagrams"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

NFPA 70 "National Electrical Code"

IPS (IRANIAN PETROLEUM STANDARDS)

[IPS-M-IN-250](#) "Materials and Equipment Standard for Distributed Control System (DCS)"

[IPS-C-IN-190](#) "Installation and Construction Standard for Transmission Systems"

3. UNITS

This Standard is based on International Systems of Units (SI), as per [IPS-E-GN-100](#) except where otherwise specified.

4. FRONT- END ENGINEERING**4.1 General**

4.1.1 For economical justification, Distributed Control System (DCS) should be considered for applications involving more than 32 analog loops. The figure is assumed on hardware cost per loop basis, and may be slightly changed depending on the number of control loops per each controller module. The project job specification shall be carefully studied by Vendor and the system shall meet the project requirements. Any deviation of project requirement shall be written to Purchaser for investigation, checking and approval.

4.1.2 The required frequency of execution for each loop shall be carefully checked by Vendor and the Company/ Consultant engineer. The frequency of execution of each loop shall be set by the Vendor in the factory and shall be checked to be based on response time of the controlled variable to the changes in the manipulated variable. In system sizing by Vendor, enough time slots shall be allocated to fast loops to reach to the suitable frequency of execution for the encountered loop.

4.1.3 In selection the number of controllers per controller module, it shall be noted that the increased number of loops per controller module has the advantage of decreasing the communication load on data highway. But, anyhow, selection shall be made according to the Vendor's controller types and his highway communication speed available.

4.1.4 DCS Controllers shall not be considered indiscriminately on fast critical loops, such as; low-range furnace pressure and compressor surge control loop because of additional dead time inherent to digital control. This precaution shall be considered in designing the instrumentation of process Piping and Instrumentation Diagrams (P & ID'S).

4.1.5 Calculation models utilizing; large arrays, iterative algorithms, sophisticated mathematical functions, or extensive subroutine calls should not be considered in DCS. These advanced controls and calculations shall be applied when process automation computer or minicomputer are employed as level 3 of Computer Integrated Manufacturing hierarchy (refer to Appendix B2).

4.1.6 For each project, the following engineering documents shall be prepared at least by the Company/Consultant engineer to be added to the [IPS-M-IN-250](#) as a front-end engineering phase:

- 1) System configuration block diagram (control hardware and software requirements)
- 2) Control philosophy
- 3) PCS function list
- 4) P & ID
- 5) Process Flow Diagrams and Specifications (PFD)
- 6) Plot Plans
- 7) Control buildings layout with main cable routing on plant layout
- 8) Alarms & Event list
- 9) I/O list
- 10) Safety Instrumented Systems reports
- 11) Hazardous area classification
- 12) Segment allocation for fieldbus system
- 13) Communication protocol and I/O mapping for third party sub systems
- 14) Job specification

4.1.7 Adequate number of Monitor and workstations shall be requested, considering plant operation and monitoring requirements, allowing simultaneous operation, diagnostics and maintenance procedures.

4.1.8 The supplied equipment must be designed for the maximum reliability and minimum downtime as required. The system shall have a high degree of tolerance to hardware malfunctions, software and operator miss-keying. Any fault, which develops, shall have its effect localized from that part of the system.

The required reliability shall be achieved through a fault tolerant design, advanced diagnostics and state of the art redundancy schemes.

4.1.9 System availability considerations will result in redundancy requirements and special topology designs in controllers, highways, communication networks, data acquisition, consoles and field instrumentation. Availability considerations generally also require power distribution systems that

provide redundant or backup sources of power. For instance, separate trains of critical equipment are usually controlled from separate subsystems in order to prevent a common failure from taking down multiple trains and these systems are powered in a manner such that single failures will not compromise control or view. The availability considered by Vendor shall be approved by Company. For detail information, refer to MIL-HDBK-217 and IEC 60863.

4.1.10 The system shall be designed such that all key elements of the system, including controllers, storage devices, communication modules and media, power supplies and other major system elements are provided in automatic dual redundant configurations.

4.1.11 The system shall continuously check itself and report any malfunction, hardware or software. Clear diagnostic messages and alarming shall be available on the station displays indicating tag address, nature and severity of the defect and time and date.

4.1.12 The system shall be modular such that an easy expansion from a small system to a large system can be made. The Vendor shall describe the future expansion and upgrading philosophy of the installed system in terms of limits of capability and ease of implementation. The description shall include the expansion and upgrading aspects of control, HMI interfaces, historian records, system database, applications, operating system, hardware and communications.

4.1.13 The system shall be able to be connected with upper level computers and networks using Company approved protocol such as OPC.

4.1.14 The system shall be able to connect to dedicated control and monitoring systems for third party subsystems such as PLCs, Tank Gauging etc., according to the job specification.

4.1.15 Technology Selection

A review of candidate technologies should be performed to ensure that the following have been addressed.

- Does the technology meet the functional requirements?
- Is the technology consistent with commercial requirements?
- Have the lifecycle cost considerations been addressed in technology selection? This includes training, maintenance and long term operation issues as well as initial costs.
- Has the potential obsolescence of the technologies been assessed?

The technology selection for the Process Control System specification should be sufficiently narrow to allow the following:

- Identification of the Process Control System physical requirements.
- Identification of software operating systems applications and quantification of impacts upon design and support costs.
- Identification of basic control technologies, such as centralized systems, Distributed system, fieldbus based systems and identification of major functional equipment such as continuous control, discrete control and Safety Instrumented Systems.
- Identification of system integration requirements between Process Control Systems and other business applications.

4.1.16 Advanced Process Control Systems

PCS shall be capable to use Advanced Process Control Systems based on project job specification. Advanced Process Control System is applied to any control system application that has functions beyond those commonly associated with regulatory control systems. An advanced process control systems application may be characterized by any of the following:

- A control system that controls or manipulates multiple variables in order to maintain one or more operating objectives.
- A control system that performs calculations beyond those that could normally be performed using standard algorithms available in PCS systems or multi-loop controllers.
- A control system that may utilize a significant number of PCS standard algorithms connected together in a complex manner.
- A control system that is executed in a higher level computing resource such as a process control computer or implemented in a programming environment at lower control levels, irrespective of the complexity of the computations.

For more information refer to API RP-557.

4.2 System Configuration Diagram

4.2.1 The system configuration shall be prepared in block diagram form to indicate the PCS functions, other equipment and corresponding functional interfaces, schematically.

4.2.2 The choice of the size of PCS shall be made based on the type, geographical concentration of control loops, plant unit distribution, and the number of control functions that must be performed at the local level. Also, in selection of controllers, the level of intelligence (processor power, flexibility) and security requirement shall be considered.

4.2.3 In system configuration diagram, quantity of operator consoles and the plant units to be controlled by each Human Machine Interface (HMI) station shall be clearly defined.

4.2.4 A sample function block diagram has been included in Appendix B1 for information only.

4.3 Control Philosophy

4.3.1 A control philosophy shall be prepared for each project. The document shall define, in general terms, the project for which the control system is to be provided with the battery limits clearly stated.

4.3.2 The control philosophy shall indicate the environmental conditions of the project, such as temperature limits, humidity limits, contaminants in the ambient atmosphere, and the area classification (as defined by API-RP 500).

4.3.3 The control rooms in the plant and the allocation of the plant units to each control room shall be clearly defined in control philosophy. Also, it shall be set that either a single central auxiliary room will be considered for the plant to house the PCS equipment or a geographically distributed auxiliary rooms will be considered. In latter case, the layout of auxiliary rooms shall also be attached to the control philosophy document, indicating all existing equipment and obstacles and classification of areas.

4.4 DCS Function List

4.4.1 DCS control, indication, alarm, manual stations list shall be prepared for all the plant, which shall be divided in plant units.

4.4.2 The DCS function list shall be similar to the conventional instrument indices, showing the control and other functions resident inside the DCS.

4.4.3 A sample function list form has been included in Appendix A1.

4.5 Process Flow Diagrams and Specifications

The process flow diagrams, description and specifications provide the basis for establishing the Process Control System functional requirements. The data contained in these documents assist in defining the size of the Process Control System and the control functions required. The characteristics of the process will also form the basis for identification of requirements for Process Control System security, robustness and speed of response.

4.6 Plot Plans

Plot plans show the location of all process equipment and significant support facilities such as control centers, satellite control houses or remote instrument enclosures, analyzer buildings, local control equipment, etc. These documents provide the basis for defining the location and approximate quantities of Process Control System equipment and identification of communications system requirements.

4.7 Safety Instrumented Systems Reports

Process HAZOP should have been performed and any needed Safety Instrumented Systems or other protective instrumented systems should have been identified and their safety integrity levels determined. This activity includes initiating work on the safety requirements specification and supporting documentation.

4.8 Questionnaire

A questionnaire form may be attached to the bid documents to be used for PCS features provided by Vendor in his proposal. This document may be used in conjunction with the clarification meetings later on, for cross check of Vendor's information. For more information refer to clause 2.3.1 of API 554.1.

5. ITEMS TO BE CLARIFIED BY PCS VENDOR

The following articles explain the important features of the PCS which may also be used for evaluating different brands of PCS, as a minimum. These items shall be definitely and formally clarified by PCS bidders.

5.1 System Capabilities and Redundancy Requirements

- Safety measures
- Maximum loops and points handling capability
- Incremental expansion capacity
- Historical trend maximum recording hours
- Future expansion capacity of the system without any change in the system proposed
- Operator training time requirements and quality of training

- Engineering and maintenance training time requirements and quality of training
- Connectivity to other manufacturer devices
- Functional and geographical distribution capabilities
- The number and location of higher level computers or other control computing resources and the number and location of computers or computing resources required to support other business functions.
- The types, general layout and routing of fieldbus/fieldbuses and other communications connections with field instrumentation and systems.
- The types, general layout and routing of process control and business communications networks. This includes peer-to-peer process control communications, hierarchical communications, field networks and business networks.
- Operating and maintenance communications systems requirements such as radio, telephone and video systems.

5.2 Process Controllers and I/O's

5.2.1 Controllers

- Functional capability
- Type and speed of microprocessor employed
- RAM capacity
- ROM type and capacity
- Maximum cycle time
- Scanning rate
- Redundancies
- Capability to use portable workstations (local operator panel)
- Number of loops to be included in each microprocessor-based controller module
- Control loop accuracy and time response
- Type of back-up batteries used in microprocessor controller modules

5.2.2 I/O modules

- I/O types and capability of each type
- I/O redundancy requirements
- Each type of I/O cards variety comparing to I/O cards proposed for the project
- I/O resolution

5.3 Networks and Communication Medium

- Data transmission capacity for each redundant Networks
- Protocol employed, its advantages and limitations
- Capacity of data stations (nodes) in each Networks
- Maximum covering length
- Proposed Networks layout

- Switching time effect between redundant Networks
- Type of redundancy, speed, transmission media and switching requirements

5.4 Work Stations

- Number of Monitor proposed per work station and ultimate capacity of work stations for Monitor
- Monitor type, size and resolution
- Functional types of operator consoles and similarity of different types
- Operating system
- Application softwares and related licensors
- Microprocessor or Computer used in operator station, architecture and redundancy of intelligence among operator consoles
- Microprocessor; redundancy, type and speed
- RAM capacity
- Floppy/zip diskette, CD/DVD (RW) drives; type, quantity and expansion capability per operator console
- The specification and quantity of USB, serial/parallel and network ports
- VGA specification
- Main memory; capacity, cycle time, and reliability figure
- Hard disk; type, capacity, speed, redundancy, reliability, etc.
- Keyboards; type, arrangement, and function
- Printer type and speed
- Track-ball, light pen, or touch screen provision
- Touch-screen type
- Video-copier type, speed and buffer size

5.5 Trending

- Maximum real-time and historical trending capacity
- Frequency and type of real-time and historical trendings
- Display time span and ranges

5.6 Interfacing

- Interfacing for packaged units and automation computer
- Types, functions, capacity and communication speed of each type of interface
- Types of protocols supported
- Electronics employed and their functions
- Diagnostic routines and hardwares available

6. SYSTEM DESIGN ENGINEERING AND DOCUMENTATION REQUIREMENTS

6.1 General

6.1.1 Detail design engineering basically is performed by the Vendor in close cooperation with Company/Consultant engineer. However, there are some operational needs for each project that must be documented and transferred to the Vendor to be considered in his detail design activities.

6.1.2 The documents, to be prepared by Vendor in charge of the project, are listed below:

- Overview display configuration
- Graphic display configuration
- Group display configuration
- Control configuration
- Trend grouping
- Alarm list
- Alarm and data logging requirement

6.1.3 The following drawings must be prepared by engineering body in charge of the project, based on Vendor's information after issuance of the purchase order:

- Field instrumentation, interfacing drawings
- Control room(s) design
- Electrical drawings (i.e., wiring, cable routing and terminations)

6.2 Documents to be Prepared for PCS Configuration (by Vendor with Company Approval)

6.2.1 Overview display configuration

6.2.1.1 Overview display shall be prepared to indicate the arrangement of group displays for ease of operation, considering the logical relationship between different groups.

6.2.1.2 Each overview display page shall not contain more than 32 groups.

6.2.1.3 A typical sample form is included in Appendix A2 to be used for overview display configuration documenting.

6.2.2 Graphic display configuration

6.2.2.1 Graphic display pages shall be prepared based on P & IDs. The graphic pages design shall allow some suitable overlapping on each page of display relative to the next pages, if required.

6.2.2.2 Each graphic display page shall contain at least one process equipment with all pertinent accessories and control loops. The contents of each display page shall not be more than one plant unit's process equipment. Anyhow, the number of points per display should not be considered more than 50 points.

6.2.2.3 Graphic display pages shall be prepared to be configured into the system by Vendor.

6.2.3 Group display configuration

6.2.3.1 Group displays shall be prepared based on control loops pertaining to a single process equipment or controls to be observed simultaneously.

6.2.3.2 Maximum number of process Tag No. per each group shall not be considered more than eight loops.

6.2.3.3 A sample form has been included in Appendix A3, that shall be used for group display configuration documenting.

6.2.4 Control configuration

6.2.4.1 For each control loop or point in the system, the control configuration Data Sheet form in Appendix A4 shall be filled (common responsibility of Consultant and Vendor).

6.2.4.2 For control loops containing trending display, the trend time scale shall also be added in this form.

6.2.5 Trend grouping

Trend grouping requirements shall be indicated, considering the operational requirements. A sample form for this purpose is included in Appendix A5.

6.2.6 Alarm list

Alarm list shall be prepared indicating all alarms to be considered in the system (process alarms only). A sample form in Appendix A6 may be used for this activity.

6.3 Electrical Design Requirements

6.3.1 AC power wiring and distribution

6.3.1.1 The power supplied to the instrumentation system should be isolated from the power supplied to all other functions in process control system. A separate distribution system shall be considered for each building containing instrumentation equipment. The isolation may be provided either by an isolation transformer or by UPS.

6.3.1.2 All AC power for the PCS cabinets and consoles shall be routed from a dedicated circuit breaker. The AC power requirements for the consoles or cabinets must be provided at the point of connection to the equipment.

6.3.1.3 The distribution system shall be reliable taking into account; sizing the power source according to the loads it will supply, power isolation and line conditioning to eliminate electrical noise, protecting the system power outages or fluctuations.

6.3.2 DC power wiring and distribution

6.3.2.1 Controller, I/O module, or communication devices contained in PCS cabinets are powered by system power supply units. All DC power wiring and distribution design shall be accomplished according to Manufacturer's recommendations.

6.3.2.2 Routing of I/O wires shall be designed to be away from noise-producing equipment.

6.3.3 Control signal wiring

6.3.3.1 Design of control signal wiring shall be according to [IPS-C-IN-190](#), "Transmission System".

6.3.3.2 Electrical power transient effect on signal wiring shall be protected according to IEEE C 62 Standard.

6.3.4 Ground wiring

6.3.4.1 Since poor grounding design are among the most common causes of electronic system problems, complete grounding design shall be accomplished according to system Manufacturer's requirements and recommendations.

6.3.4.2 Screens shall be designed to be insulated from each other and earthed only at one point. That is:

- a) For IS circuits, at the IS earth bar,
- b) For non IS circuit, at the panel reference bar,
- c) For field earthed instruments, at the field junction box.

6.3.5 Network communication media cabling

6.3.5.1 Redundant network cables for PCS shall be run by separate routes unless otherwise approved by Company. It is important to carefully consider routing to minimize the risk of simultaneous failure of both networks due to mechanical damage, fire and so on.

6.3.5.2 Methods of installation also needs to be considered early in the design, since long lengths may be involved and some cable manufacturers requirements create difficulties in laying (e.g. restricting number of connections). It is often easier to lay the cable in trenches or on cable trays rather than pulling through conduits (e.g. under pipe tracks or roads).

6.3.5.3 Design of network communication cabling shall be according to [IPS-C-IN-190](#), "Transmission System".

APPENDICES**APPENDIX A1**[SHEET 1 OF 2](#)

APPENDIX A1 (continued)

[SHEET 2 OF 2](#)

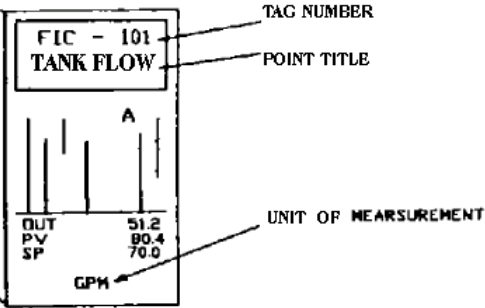
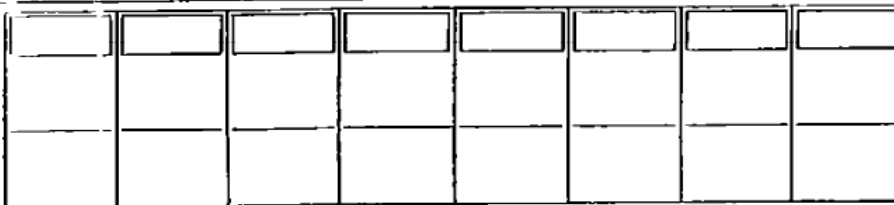
APPENDIX A3

JUB NUMBER. _____ ITEM NUMBER _____
 PURCHASE ORDER NO. _____
 INQUIRY NO. _____
 SPEC. SHEET. _____ PAGE _____ OF _____

REV.				
DATE				
APRD.				

DCS GROUP DISPLAY CLASSIFICATION DATA

OVERVIEW PAGE NO. _____ GROUP DISPLAY NO. _____



NO.	TAG NUMBER	POINT TITLE	UNITS OF MEASUREMENT	TIME SLOT NUMBER	CONTROLLER CARD NUMBER

APPENDIX A4

JUB NUMBER. _____ ITEM NUMBER _____
 PURCHASE ORDER NO. _____
 INQUIRY NO. _____
 SPEC. SHEET. _____ PAGE _____ OF _____

REV.				
DATE				
APRD.				

DCS CONTROL CONFIGURATION DATA SHEET							
OVER VIEW PAGE NUMBER		GROUP NUMBER		TAG NUMBER		P & ID NUMBER	
CONTROLLER DEFINITION	1	INPUT 1 RANGE		PID FUNCTION	27	ERROR GENERATION	
	2	INPUT 2 RANGE			28	OUTPUT LIMITING	
	3	UNITS OF MEASUREMENTS			29	OUTPUT TRACKING	
	4	AUTO / MANUAL			30	FEED FORWARD	
	5	PID			31	ANTI - RESET WINDUP	
	6	PID RATIO			32	SET - POINT CLAMPING	
	7	PIU - FLOATING			33	SUMMER	
	8	ADAPTIVE TUNING			34	MULTIPLIER	
	9	CASCADE MODE			35	MEDIAN	
PARAMETRES RANGE	10	PROPORTIONAL BAND		COMPIOTATION	36	LEAD / LAG	
	11	RESET			37	HIGH SELECT	
	12	PATE			38	LOW SELECT	
	13	DIAS			39	SQURE ROOT	
	14	RATIO			40	LOG FUNCTION	
	15	SET - POINT RAMP			41	EXPONENTIAL	
	16	DEAN BND			42		
	17	CASCADE MULTIPLIER			43		
ALARM LIMITS	18	PV1 HI		COFIGURATION PARAMETERS	44	CONFIGURATION NO.	
	19	PV1 LO			45	SLOT NUMBER	
	20	PV2 HI			46	COTROLLER CARD NO.	
	21	PV2 LO			47	TREND GROUP NO	
	22	DEVIATION HI			48	ALARM GROUP NO.	
	23	DEVIATION LO			49		
	24	OUTPUT HI			50		
	25	OUIPUT LOW			51		
	26	OUTPUT RATE			52		

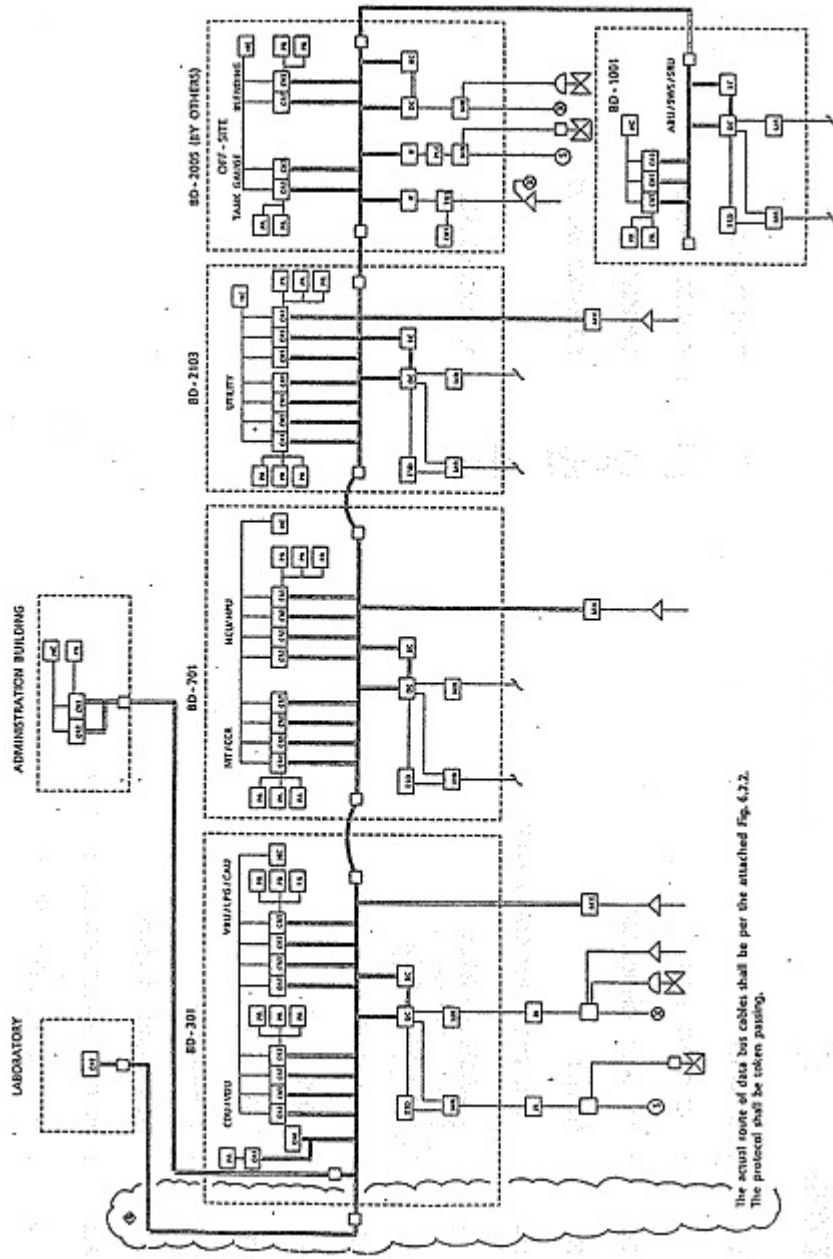
APPENDIX A5

JUB NUMBER. _____ ITEM NUMBER _____
 PURCHASE ORDER NO. _____
 INQUIRY NO. _____
 SPEC. SHEET. _____ PAGE _____ OF _____

REV.				
DATE				
APRD.				

DC TREND GROUPING							
ALL ITEMS SHALL COMPLY WITH AND GENERAL SPECIFICATION SHEET							UNIT
GROUP	TE NO.	POINT TAG N1	SERVICE	RANGE	TIME SCALE	TREND COLOR	UNIT OF MEASUREMENT
	1						
	2						
	3						
	4						
	5						
	6						
	1						
	2						
	3						
	4						
	5						
	6						
	1						
	2						
	3						
	4						
	5						
	6						
	1						
	2						
	3						
	4						
	5						
	6						
NOTS :							








APPENDIX B1
TYPICAL SYSTEM CONFIGURATION (for control rooms)
(SHEET 1 OF 2)



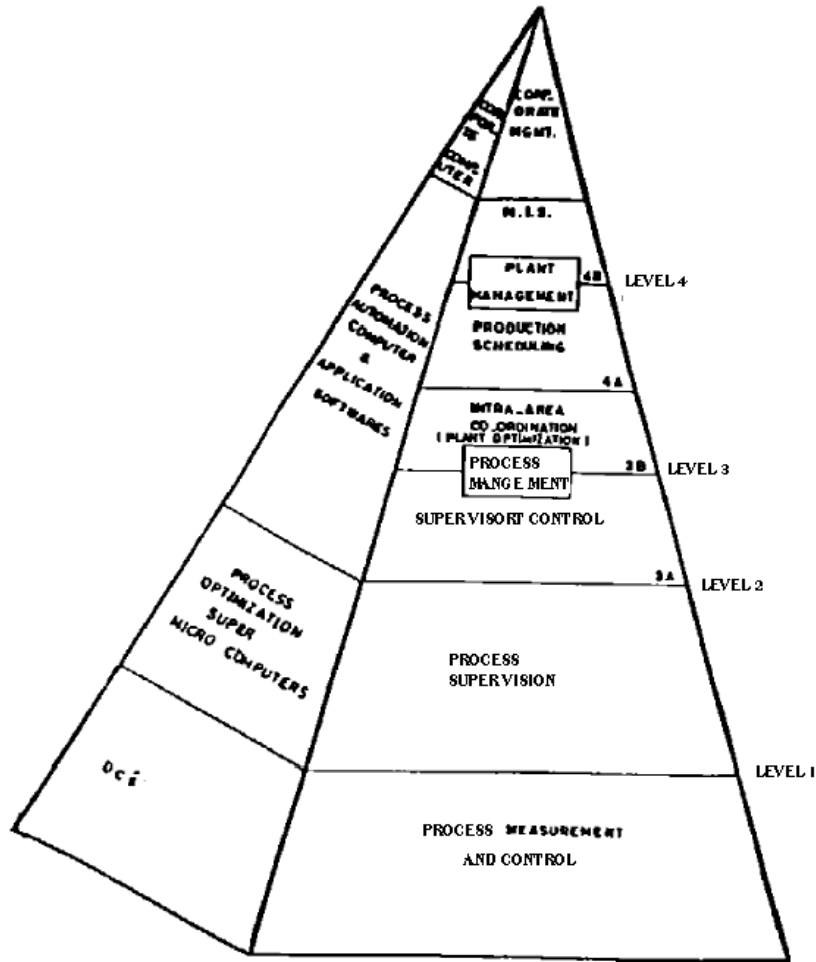
(to be continued)

APPENDIX B1 (continued)

SHEET 2 OF 2

LEGEND		
CRT	: CRT CONSOLE	 : TRANSMITER
DC	: DCS CONTROLER	 : CONTROL LVES
BC	: BACK –UP CONTROLER	 : SWITCHES
PR	: PRINTER	 : SOLENOLD VALVES
ESD	: EMERGENCY SHUT DOWN RACK	
MR	: MARSHALLING RACK	 : THERMO COUPLES
CM	: COMPUTING MODULE	
MX	: MULTI – PLEXER	
M	: MODEM	
HC	: HARD COPIER	
IF	: INTERFACE UNIT	
TGS	: TANK GAUGING SYSTEM	
PLC	: PROGRAMMABEL LOGIC CONTROLLER	
BLD	: BLENDING CONTROL SYSTEM	
JB	: JUNKTION BOX	

APPENDIX B2



B2 - COMPUTER INTEGRATED MANUFACTURING (CIM) MULTIPLE LEVELS OF PROCESS EQUIPMENT AND INFORMATION

PART 2

CONSTRUCTION STANDARD

FOR

PROCESS CONTROL SYSTEM (PCS)

CONTENTS:

PAGE No.

1. SCOPE	26
2. REFERENCES	26
3. UNITS	26
4. SITE PREPARATION	26
4.1 General.....	26
5. WIRING AND CABLING REQUIREMENTS	27
5.1 General.....	27
5.2 Intrinsically Safety	27
5.3 Wiring and Cabling	27
5.4 Requirements for Power Distribution System	28
6. INSTALLATION OF PCS EQUIPMENT	28
6.1 General.....	28
6.2 PCS Enclosures Installation	29
6.3 Communication Media Cabling	29

1. SCOPE

This Standard covers the general technical requirements to be considered in PCS installation for petroleum industries projects.

It should be noted that each brand of PCS has its own installation precautions and procedures. Therefore the installation shall be performed under close supervision of the PCS Vendor according to manufacturer's instructions.

General installation works shall be in accordance with [IPS-C-IN-100](#) Standard.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The edition of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be agreed upon by the Company.

ISA (INSTRUMENT SOCIETY OF AMERICA)

RP 12.4	"Pressurized Enclosures"
ANSI/ISA-RP12.06.01	"Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

NFPA 75	"Standard for the Fire Protection of Information Technology Equipment"
NFPA 70	"National Electrical Code"
ANSI/NFPA 496	"Standard for Purged and Pressurized Enclosures for Electrical Equipment"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-C-IN-190	"Installation and Construction Standard for Transmission System"
IPS-C-IN-100	"Construction and Inspection Standard for General Instruments, Field Inspection, Calibration and Testing of Instruments and Instrument Systems"
IPS-C-EL-115	"Construction Standard for Electrical Installation"

3. UNITS

This Standard is based on International Systems of Units (SI), as per [IPS-E-GN-100](#) except where otherwise specified.

4. SITE PREPARATION

4.1 General

4.1.1 Before the PCS equipment arrives at the plant, all site preparation works must be completed to make sure that the system can be installed with a minimum difficulty.

4.1.2 The Contractor and inspector body shall make sure that the PCS equipment can get through the pertinent doors, that proper electrical utilities are ready and waiting for hookup, and that the operating environment is suitable for a typical PCS and its pertinent peripherals.

4.1.3 For details on control room requirements reference may be made to [IPS-C-IN-100](#).

5. WIRING AND CABLING REQUIREMENTS

5.1 General

5.1.1 All wire and cable shields shall be connected to the earth ground either directly or through the ground bus. In this respect Vendor's recommendations and connection to earth shall be strictly followed.

5.1.2 Conduit, armor and trays containing the PCS wiring shall be properly grounded.

5.1.3 All shields shall be connected to the earth ground at control room terminating point, to prevent ground loop problems.

5.1.4 The power wiring shall be performed in accordance with [IPS-C-EL-115](#), "Electrical Installation Standard".

5.1.5 The twisted pair cables used shall have minimally 20 crossover per meter to limit electromagnetic noise. The signal wires and cables shall be of a type to minimize noise pick-up, as stated in [IPS-C-IN-190](#).

5.1.6 Routing of I/O wires shall be performed in a manner to be away from noise-producing equipment. Signal cables should not be routed in troughs, wireways, pipes or conduits containing power cables.

5.2 Intrinsically Safety

5.2.1 Where the field instruments are installed in hazardous or explosive environment, the pertaining I/O equipment shall meet intrinsically safe standard as described in ANSI/ISA RP12.06.01 unless otherwise specified in project job specification the explosionproof type is acceptable.

5.2.2 Barrier grounds for intrinsically safe system shall be tied directly to instrument earth ground. Barrier ground shall be connected to a grounding electrode by redundant, 12 AWG or larger insulated conductors.

5.3 Wiring and Cabling

5.3.1 All wires and terminals shall be clearly labeled. The labels shall be durable and unambiguous, and also color coding for the labels shall be employed. For details reference shall be made to [IPS-C-IN-190](#).

5.3.2 Careful consideration shall be given for execution of low-level signal sources, such as thermocouples, for elimination of any external noise or interferences.

5.3.3 Cables shall be run in the shortest possible routes without any joint or splices.

5.3.4 Cabling along vibrating supports shall be avoided.

5.3.5 Bends on two core cables shall be performed with minimum 10 cm radius.

5.3.6 In order to avoid ground loop problems, the cable shields shall be grounded at the cabinet end of the cable only. All such cables shall be systematically connected and inspected.

5.3.7 As each module wiring is completed, check of the wirings shall be performed for mechanical strength and verifying the labeling.

5.3.8 The communication media trunk cable may be tray or underground mounted as shown on installation drawings. Cables shall be installed according to the project drawings considering all requirements specified by PCS Vendor.

5.4 Requirements for Power Distribution System

5.4.1 The foremost requirement of any power distribution is safety. The system shall protect personnel from electrical shock hazards or other potential hazards, such as fires, that could result from a substandard electrical system. Generally, the requirement of NFPA 70 shall be considered in power distribution system.

5.4.2 Power cables shall be run between power distribution panels and the PCS enclosures as indicated on the pertinent drawings. Cabling shall be allowed approximately 1.5 meter extra length of cable at the power distribution panel end of the power cable and 2 meter at the PCS enclosure end of the power cable to accommodate routing within the panel and/or the enclosure.

5.4.3 An earth conductor shall be connected between the plant earth grid and the pertinent earthing point (e.g., earth bus-bar) within each equipment enclosure in order to ensure a zero-voltage earth reference to be achieved.

5.4.4 The earth cable shall have green/yellow colored cover insulator.

6. INSTALLATION OF PCS EQUIPMENT

6.1 General

6.1.1 Prior to arrival of the equipment at the site or before installation work commencement, the following checks shall be performed:

- 1)** There is sufficient space for moving the equipment from the transportation vehicle to the installation area.
- 2)** Adequate space has been provided for all equipment.
- 3)** The installation environment conforms with the Vendor's specification.
- 4)** The floor covering of the installation site will suppress generation of static electricity.
- 5)** Appropriate power (voltage, frequency, and current rating) is available for the system.
- 6)** A power distribution panel with properly rated circuit breakers is provided for the system.
- 7)** AC power receptacles are provided for peripheral equipment, where required.
- 8)** Process field wiring is properly sized and connected to marshaling racks.
- 9)** Lengths of ordered cables are sufficient and consistent with constraints set forth in Vendor's documents.

6.1.2 PCS installation requires uncrating, inspection, move-in, and placement of equipment, after performing all cabling and control room finishing. Cabinet cable, power, and ground connections shall be made afterward, according to Vendor's installation documents. Power-up shall be only carried out in presence of manufacturer's representative.

6.2 PCS Enclosures Installation

6.2.1 For enclosures with cable or conduit entry from the bottom, the following activities should be performed by the installation Contractor:

- a) The bottom conduit enclosure plate shall be removed and drilled or punched according to the requirements and appropriate gland or conduit fittings shall be installed on the plate.
- b) The enclosure conduit plate should be placed on the floor or the bottom of the enclosure in the precise location.
- c) Installation of the enclosure shall be forwarded as outlined herein.

6.2.2 The enclosure shall be positioned with all required mounting accessories, so that the holes in the enclosure base, gaskets and other mounting accessories are aligned with the mounting holes or bolts in the floor. The bolts, flat washers and lock washers shall be installed with nuts. After installing the bolt nuts, tightening shall start from center to outside bolts evenly and equally, being careful not to be overtighten.

6.2.3 For other types of enclosure, reference shall be made to Manufacturer's recommendation for installation procedure.

6.3 Communication Media Cabling

6.3.1 The communication media trunk cable may be tray or underground mounted as shown on installation drawings. The Contractor shall install the cables according to the project drawings considering all requirements specified by PCS Vendor.

6.3.2 Underground cabling shall be performed in concrete duct. Construction shall meet the following requirements:

- Trunk cable duct should enter the building below ground level, via a manhole to minimize cable bending.
- Single duct run should not exceed 90 m. Where this is not possible, manholes shall be provided to shorten the run.
- Ducts must have 100 mm, inside diameter minimally to facilitate installing redundant communication trunk lines.
- All duct runs should be straight, where impossible, suitable manholes shall be constructed to allow pulling the cable in separate lengths and splice them at the bend. Splicing of the cable shall be kept to minimum.

6.3.3 Branch spurs on underground cables shall be made via suitable manholes. The branch cables shall be run either on PVC conduits or 10 cm tray system, as may be applicable.