ENGINEERING & CONSTRUCTION STANDARD

FOR

DISTRIBUTED CONTROL SYSTEM (DCS)

FOREWORD

This Standard has been prepared in two parts as follow:

Part 1: "Engineering Standard for Distributed Control System (DCS)"
Part 2: "Construction Standard for Distributed Control System (DCS)"

PART 1
ENGINEERING STANDARD
FOR
DISTRIBUTED CONTROL SYSTEM (DCS)

0. INTRODUCTION

In the total schedule of engineering of DCS, as all other control systems, the Company/Consultant engineer activities are interleaved with Vendor's activities. The Company/Consultant engineer major activities are:

a) Front-end engineering, consisting of the following activities:

1) Preparation of; system overall configuration, control philosophy, function list, I/O list
2) Bid documentation preparation
3) Evaluation of quotations and Vendor(S) selection
4) Purchasing specification, negotiations and purchase order issuance

b) System engineering:

1) Field instrumentation, interfacing
2) Control room(s) design
3) Electrical design (including wiring, cable routing and terminations)
4) Design of logs, reports and CRT displays formats
5) Detailed specification of acceptance-test procedures

CONTENTS :

PAGE No.

1. SCOPE

This Standard covers the engineering requirements to plan and design the Distributed Control System (DCS) 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.

The Company's requirements cover; the number of control rooms, and distribution of responsibilities between them, functional requirements for each control room, the displays configuration which most suitably fits the operational need of the plant control strategy requirements, and interfacing to other equipment or field instruments.

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.

SAMA (SCIENTIFIC APPARATUS MAKERS ASSOCIATION)

PMC 22.1 (1981) "Functional Diagramming of Instrument and Control System"

ISA (INSTRUMENT SOCIETY OF AMERICA)

S 5.1 "Instrumentation Symbols and Identification"

S 5.3 "Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems"

S 5.5 "Graphic Symbols for Process Devices"

IEEE (INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS)

C 62 (1990) "Guides and Standards for Surge Protection"

API (AMERICAN PETROLEUM INSTITUTE)

RP 500 "Area Classifications for Group D Hazardous Materials"

ANSI (AMERICAN NATIONAL STANDARD INSTITUTE)

Y 32.11 "Graphic Symbols for Process Equipment"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

NFC # 70 "National Electrical Code"

3. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

4. FRONT-END ENGINEERING

4.1 General

4.1.1 For economical justification, Distributed Control System (DCS) shall only be considered for applications involving more than 32 loops. The above 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.

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 (CIM) hierarchy (refer to Appendix B2).

4.1.6 For each project, the following engineering documents shall be prepared by the project, and/or 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) DCS function list
4) P & ID
5) Control buildings layout with main cable routing on plant layout
6) Alarms list
7) I/O list
8) Additional project requirements

4.1.7 Adequate number of CRT'S and operator stations shall be requested, considering plant operation and monitoring requirements, allowing simultaneous operation, diagnostics and maintenance procedures.

4.2 System Configuration Diagram

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

4.2.2 The choice of the size of DCS controller 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 Man-Machine Interface 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 DCS 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 DSC.

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

4.5 Questionaire

4.5.1 A questionaire form may be attached to the bid documents to be used for DCS 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.

5. ITEMS TO BE CLARIFIED BY DCS VENDOR

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

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 Data Highway (Communication Medium)

- Data transmission capacity for each redundant Data Highways
- Protocol employed, it's advantages and limitations
- Capacity of data stations (nodes) in each Data Highway
- Maximum covering length
- Proposed Data Highways layout
- Switching time effect between redundant Data Highways
- Type of redundancy, speed and switching requirements

5.4 Operator Stations

- Number of CRT'S proposed per operator station and ultimate capacity of operator stations for CRT'S

- CRT type (anti-glare, low radiation, etc.), size and resolution

- Functional types of operator consoles and similarity of different types

- Microprocessor or minicomputer used in operator station, architecture and redundancy of intelligence among operator consoles

- Microprocessor; redundancy, type and speed

- RAM capacity

- Floppy diskette drive; type, quantity and expansion capability per operator console

- ROM capacity and type

- Display updating time

- Main memory; capacity, cycle time, and reliability figure

- Hard disk; capacity, number of sectors, number of tracks, access time (latency plus seek), redundancy, reliability, etc.

- Keyboards; type, arrangement, and function

- Control languages employed

- 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 Project Engineer/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 engineering body in charge of the project, are listed below;

- Overview display configuration
- Graphic display configuration
- Group display configuration
- Control configuration
- Trend grouping
- Alarm list (summary)
- 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 DCS Configuration (by Engineering Body)

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 A4 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 & ID's. 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 overview 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 loops per each group shall not be considered more than eight loops irrespective of the number of loops per controller module.

6.2.3.3 A sample form has been included in Appendix A5, 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 A6 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 A7.

6.2.6 Alarm list summary

Alarm list shall be prepared indicating all alarms to be considered in the system (process alarms only). Form A8 in Appendix A8 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 DCS cabinets and consoles shall be routed from a dedicated circuit breaker panel. 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 multiplexer,or communication devices contained in DCS 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 (1990) 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 Data highway communication media cabling

6.3.5.1 Redundant data highway cables for DCS 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 highways 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).

APPENDICES

APPENDIX A1

SHEET 1 OF 2

DCS FU

ITEM NO.	TAG NUMBER	SERVICE	(1) INPUT TYPE	(2) AUX. INST.	(3) UNITS	(1) OUTPUT TYPE	(4) FUNCTION MODE

Notes:

(to be continued)

APPENDIX A1 (continued)

SIGNAL LEVEL
(INPUT, OUTPUT, TYPE)

I	:	4-20mA dc
V	:	1-5Vdc
S	:	TYPE "S" THERMOCOUPLE
K	:	TYPE "K" THERMOCOUPLE
E	:	TYPE "E" THERMOCOUPLE
J	:	TYPE "J" THERMOCOUPLE
T	:	TYPE "T" THERMOCOUPLE
PT	:	RESISTANCE BULB
PLS	:	PULSE
ON/OFF	:	CONTACT

EXTERNAL CONVERTER
(AUX INST)

DIS	:	DISTRIBUTOR
MV/V	:	mV/V CONVERTER
PT/V	:	pt/V CONVERTER
AS1	:	ALARM SETTER, 1 SETTING
AS2	:	ALARM SETTER, 2 SETTING
ISO	:	ISOLATOR
F/V	:	PULSE/V CONVERTER
SCA	:	SCALER
L	:	LINEARIZER

UNITS (ENGINEERING UNIT)

	ENGINEERING UNIT	ENGINEERING UNIT (DCS)
1) FLOW RATE		
a) LIQUID	m3/hr	M3/H
b) FUEL OIL	m3/day	M3/D
c) STEAM	Kg/hr	KG/H
d) GAS & VAPOR	Nm3/hr	NM3/H
2) PRESSURE		
a) GAGE	Kg/cm^2G	KG/CM2G or BARG (EXIST)
b) ABSOLUTE	Kg/cm^2abs	KG/CM2Aor BARA (EXIST)
3) LOW PRESSURE		
a) DRAUGHT OR DIFFERENTIAL	mmH_2O	MMH_2O
b) ABSOLUTE	mmHgabs	MMHGA
4) DENSITY	KG/m3	KG/M3
5) LEVEL OR UNITLESS	%	%
6) LENGTH	m	M
7) ANALYSER		
a) pH	pH	PH
b) OXYGEN	%	%
8) TEMPERATURE	°C	.DEG C

(4) FUNCTION MODE

DDC	:	DIGITAL CON
SPC	:	SUPERVISORY
AI	:	ANALOG SIGN
AO	:	ANALOG SIGN
DI	:	ON-OFF SIGNA
DO	:	ON-OFF SIGNA
PI	:	PULSE SIGNAI
PO	:	PULSE SIGNAI

(5) MODE/ALGRTHM

a) MODE

HC	:	HAND
RATIO.	:	RATIO
OPR	:	OPERA
CAS	:	REMOT
COMP	:	REMOT
SELECT	:	AUTO
IND	:	INDICA
ALM IND	:	ALARM
XC	:	OTHER
TCP	:	TEMPE
PCP	:	PRESSU

b) ALGORITHM (DCS ALGORITHM)

P	:	PROPO
I	:	INTEGR
D	:	DERIVA
+ FB	:	WITH
+ BS	:	WITH
NL	:	NON-LI
TP-ON/OFF	:	TIME
ON/OFF	:	ON-OFF
ON/OFF-DG	:	DIFFER
ON/OFF-3P	:	THREE
1RY	:	PRIMAI
2ND	:	SECON

(6) CONTROL ACTION
(DCS ACT)

I	:	INCREASE
D	:	DECREASE
		MV AGAINST PV
FO	:	FAILURE OPEN
FC	:	FAILURE CLOSE
CAS	:	PRIMARY LOOP

(7) SEQUENCE MODE

YES	:	WHEN SEQUENCE

APPENDIX A2

JOB No. ______ ITEM No. ______
PURCHASE ORDER No. ______
INQUIRY No. ______
SPEC. SHEET ______ PAGE ___ OF ___

REV.				
DATE				
APRD.				

DCS I/O POINTS SUMMARY LIST

P&ID No. / UNIT No. / PLANT AREA No.	INPUTS															OUTPUTS														
	4-20mA					mV.				RTD	LOGIC CONTACT (FREE VOLTAGE)			PULSE	TANK GAUGING SIGNAL	4-20mA			LOGIC CONTACT											
	CONTROL				RECORDING/INDICATING	CONTROL			ACQUISITION							CONTROLLING FUNCTION	HAND CONTROL FUNCTION													
POINT TAG No.	PI PID	CASCADE	COMPUTING			PID	CASCADE	COMPUTING			INTERLOCK	ALARM FUNC	SEQUENCE						MOTOR START/STOP	SEQUENCING										

NOTES:

APPENDIX A3

JOB No. _____ ITEM No. _____
PURCHASE ORDER No. _____
INQUIRY No. _____
SPEC. SHEET _____ PAGE ____ OF _____

REV.				
DATE				
APRD.				

I/O POINTS COUNT LIST OF DCS

										TOTAL COUNT
GENERAL	1	UNIT NUMBER.								
	2									
	3									
INPUTS	4	4-20 mA	CONTROL	PL PID						
	5			CASCADE						
	6			ALGORITHM						
	7		RECORDING/INDICATING							
	8									
	9	mV	CONTROL	PID						
	10			CASCADE						
	11			ALGORITHM						
	12		RECORDING/INDICATING							
	13	RTD								
	14	LOGIC CONTACTS (FREE VOLTAGE)	INTERLOCK							
	15		ALARMS							
	16		SEQUENCING							
	17	PULSE SIGNALS								
	18	ASCII SIGNALS								
OUTPUTS	19	4-20mA	CONTROL LOOP							
	20		HAND CONTROL							
	21									
	22	LOGIC CONTACTS (FREE VOLTAGE)	MCC							
	23		SEQUENCING							
	24									
DCS FUNCTIONS	25	CONTROL LOOP								
	26	HAND CONTROL STATIONS								
	27	TRENDS								
	28	ALARMS								
	29	PUSH BUTTONS								
	30	SELECTOR SWITCHES								
	31	PL PID LOOPS								
	32	ALGORITHM LOOPS								
	33	CASCADE LOOPS								
	34	FEED FORWARD LOOPS								
	35	OTHER LOOPS								
	36	ADAPTIVE TUNING LOOPS								

NOTES:

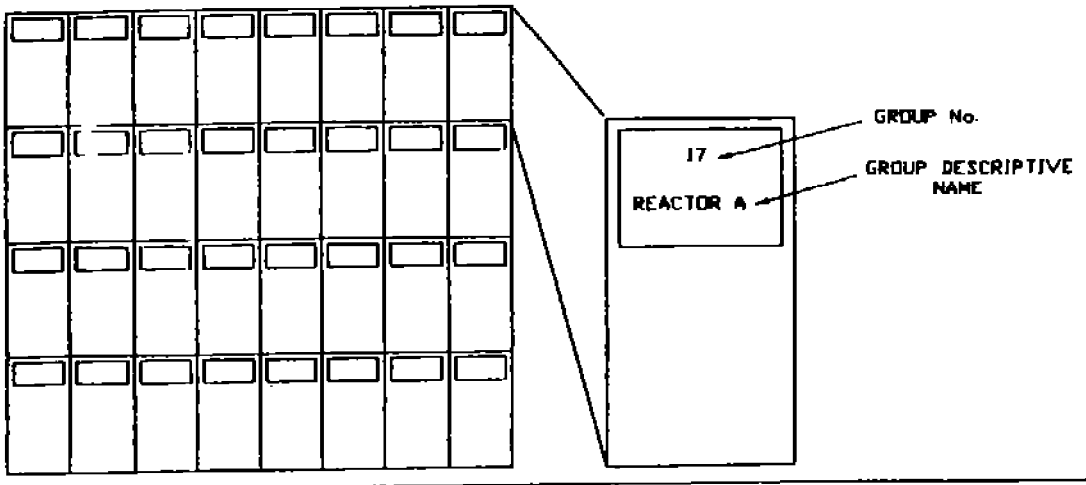
APPENDIX A4

JOB No. _____ ITEM No. _____
PURCHASE ORDER No. _____
INQUIRY No. _____
SPEC. SHEET _____ PAGE ___ OF ___

REV.				
DATE				
APRD.				

DCS OVERVIEW DISPLAY CLASSIFICATION DATA SHEET

OVERVIEW PAGE No.



GROUP No.	GROUP DESCRIPTIVE NAME	GROUP No.	GROUP DESCRIPTIVE NAME

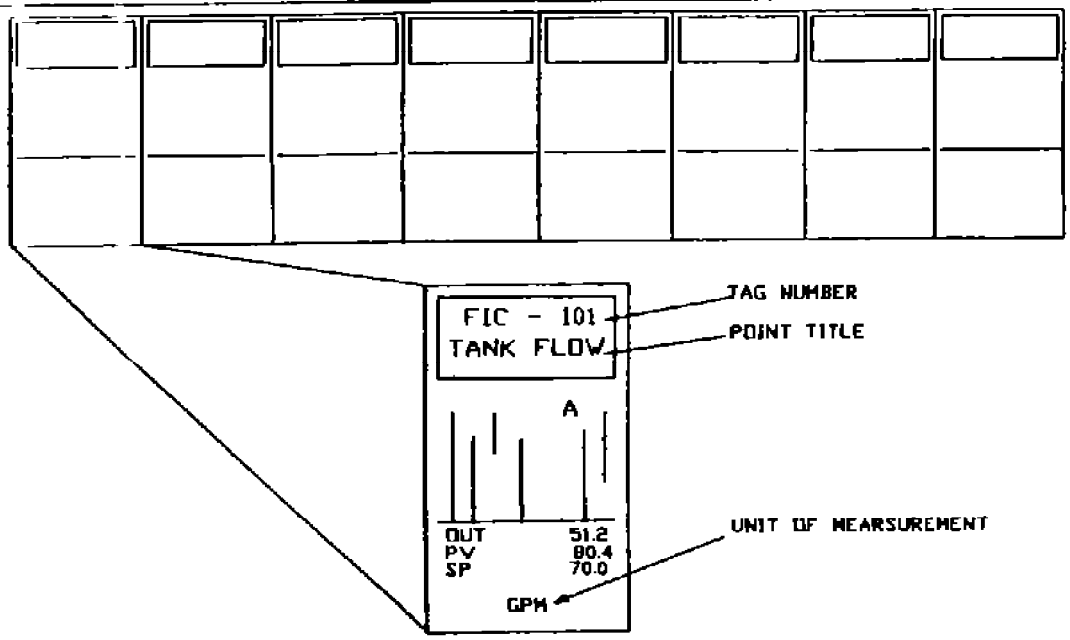
APPENDIX A5

JOB No. _____ ITEM No. _____
PURCHASE ORDER No. _____
INQUIRY No. _____
SPEC. SHEET _____ PAGE ____ OF _____

REV.				
DATE				
APPD				

DCS GROUP DISPLAY CLASSIFICATION DATA SHEET

OVERVIEW PAGE No. | GROUP DISPLAY No.



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

APPENDIX A6

JOB No. _____ ITEM No. _____
PURCHASE ORDER No. _____
INQUIRY No. _____
SPEC. SHEET _____ PAGE ___ OF ___

REV.				
DATE				
APRD.				

DCS CONTROL CONFIGURATION DATA SHEET

OVERVIEW 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 MEASUREMENT			29	OUTPUT TRACKING	
	4	AUTO / MANUAL			30	FEED FORWARD	
	5	PID			31	ANTI-RESET WINDUP	
	6	PID RATIO			32	SET-POINT CLAMPING	
	7	PID - FLOATING		COMPUTATION	33	SUMMER	
	8	ADAPTIVE TUNING			34	MULTIPLIER	
	9	CASCADE MODE			35	MEDIAN	
PARAMETERS RANGE	10	PROPORTIONAL BAND			36	LEAD / LAG	
	11	RESET			37	HIGH SELECT	
	12	RATE			38	LOW SELECT	
	13	BIAS			39	SQUARE ROOT	
	14	RATIO			40	LOG FUNCTION	
	15	SET-POINT RAMP			41	EXPONENTIAL	
	16	DEAD BAND			42		
	17	CASCADE MULTIPLIER			43		
ALARM LIMITS	18	PV1 HI		CONFIGURATION PARAMETERS	44	CONFIGURATION No.	
	19	PV1 LO			45	SLOT NUMBER	
	20	PV2 HI			46	CONTROLLER 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	OUTPUT LO			51		
	26	OUTPUT RATE			52		

APPENDIX A7

JOB NO ______________ ITEM NO. ______________
PURCHASE ORDER NO. ______________
INQUIRY NO. ______________
SPEC. SHEET ______________ PAGE ______ OF ____

REV.				
DATE				
APP'D				

DCS TREND GROUPING

ALL ITEMS SHALL COMPLY WITH ______ STANDARDS AND GENERAL SPECIFICATION SHEET | UNIT

GROUP	TR. NO.	POINT TAG NO.	SERVICE	RANGE	TIME SCALE	TREND COLOR	UNIT OF MEASURMENT
	1						
	2						
	3						
	4						
	5						
	6						
	1						
	2						
	3						
	4						
	5						
	6						
	1						
	2						
	3						
	4						
	5						
	6						
	1						
	2						
	3						
	4						
	5						
	6						
	1						
	2						
	3						
	4						
	5						
	6						

NOTES:

APPENDIX A8

JOB No. __________ ITEM No. __________

PURCHASE ORDER No. __________

INQUIRY No. __________

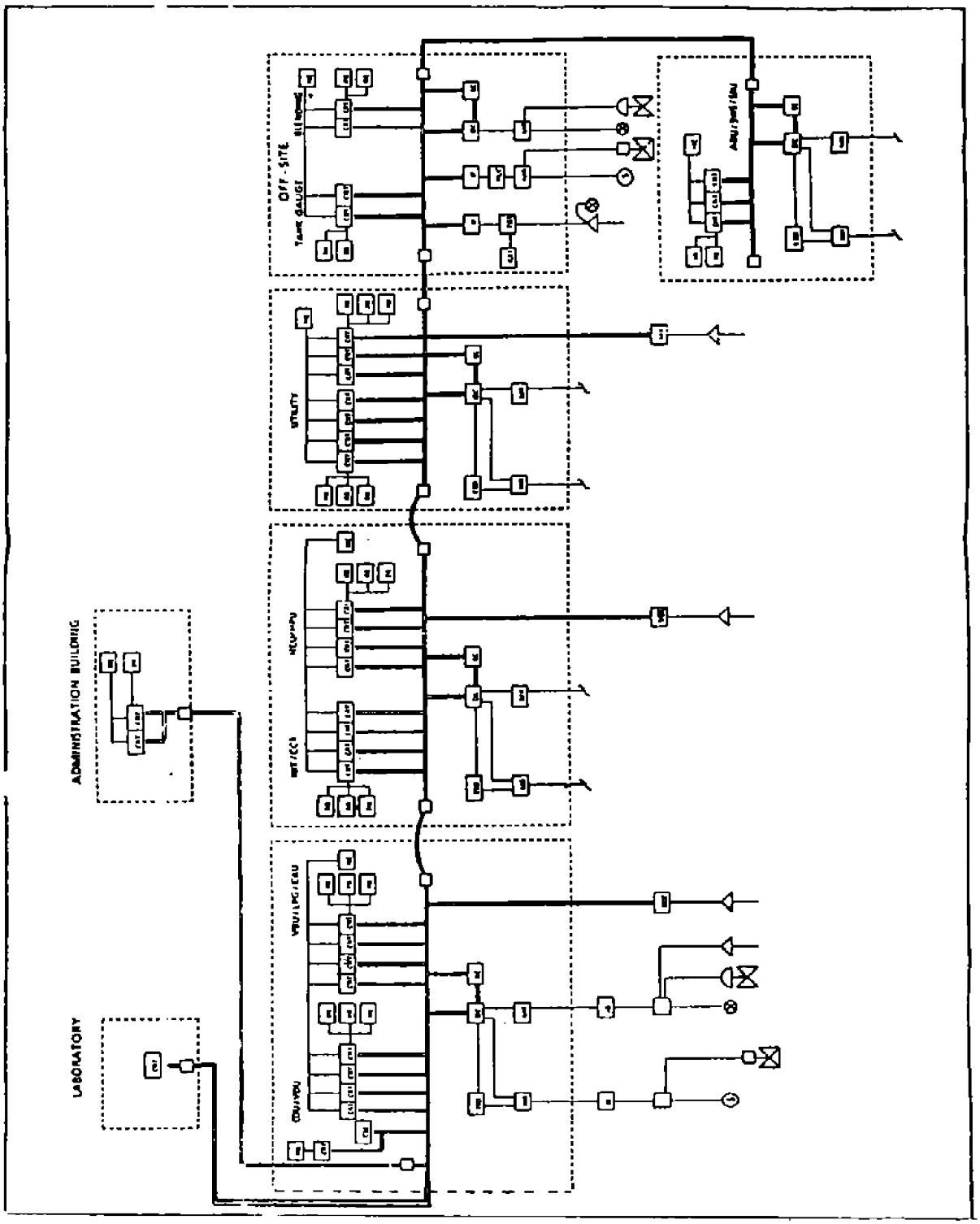
SPEC. SHEET __________ PAGE ____ OF ____

ALARM SUMMARY LIST

ITEM	TAG NO.	UNIT No	OVW No.	GROUP No.	DETAIL DISPLAY No.	ALARM DESCRIPTION

APPENDIX B1
TYPICAL SYSTEM CONFIGURATION (for control rooms)

(SHEET 1 OF 2)



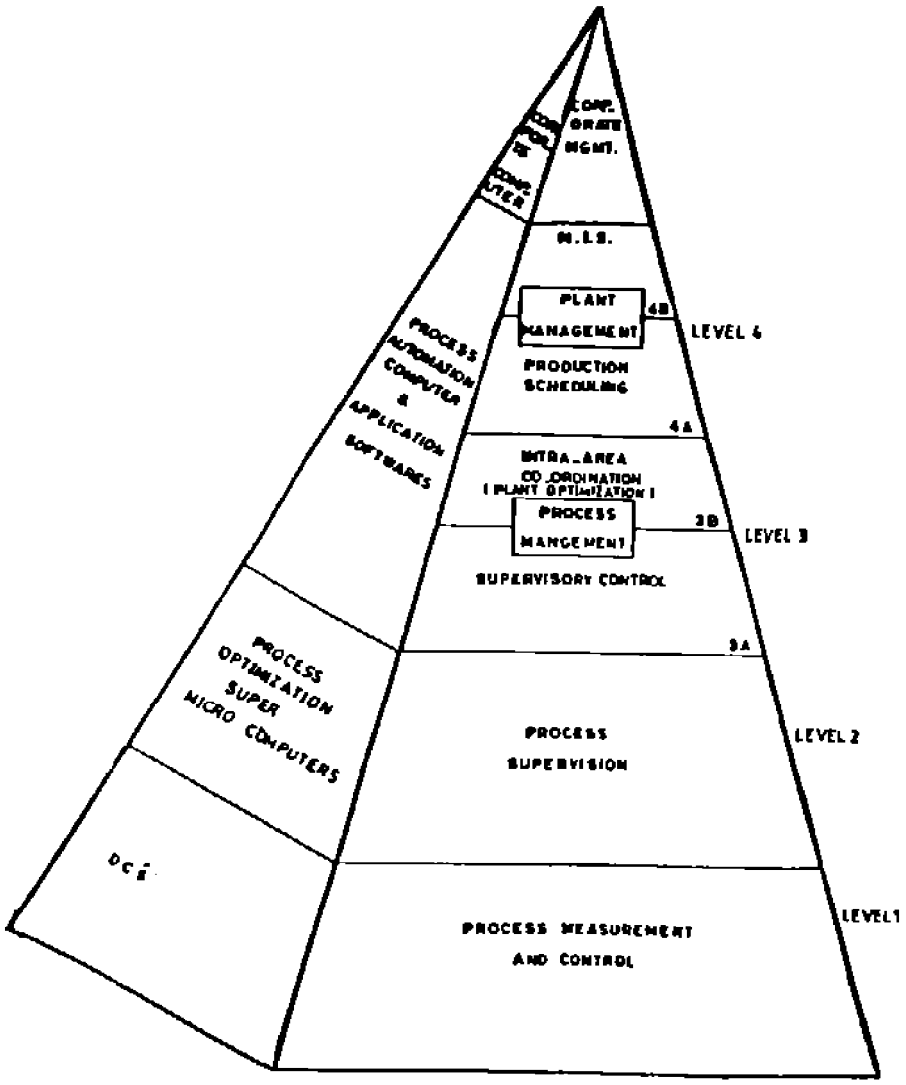
(to be continued)

APPENDIX B1 (continued)

SHEET 2 OF 2

LEGEND				
CRT	:	CRT CONSOLE	⊗	: TRANSMITTER
DC	:	DCS CONTROLLER		: CONTROL VALVES
BC	:	BACK-UP CONTROLLER	Ⓢ	: SWITCHES
PR	:	PRINTER		: SOLENOID 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	:	PROGRAMMABLE LOGIC CONTROLLER		
BLD	:	BLENDING CONTROL SYSTEM		
JB	:	JUNCTION BOX		

APPENDIX B2



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

PART 2

CONSTRUCTION STANDARD

FOR

DISTRIBUTED CONTROL SYSTEM (DCS)

CONTENTS :

PAGE No.

1. SCOPE

This Standard covers the general technical requirements to be considered in DCS installation for Iranian Petroleum Industries projects.

It should be noted that; each brand of DCS has it's own installation precautions and procedures. Therefore the installation shall be performed under close supervision of the DCS Vendor.

General installation works shall be in accordance with IPS-C-IN-100/2 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 55.1	"Hardware Testing of Digital Process Computers" = ANSI MC 8.1
RP 12.4	"Instrument Purging for Reduction of Hazardous Area Classification"
ANSI/ISA RP 12.6	"Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

ANSI/NFP A#75	"Protection of Electronic Computer/Data Processing Equipment"
NFC#70	"National Electrical Code (NEC)"

IPS (IRANIAN PETROLEUM STANDARDS)

C-IN-190	"Transmission System"
C-IN-100/2	"Construction and Installation Standard for General Instruments Instrument Installation Procedure"
C-EL-115	"Electrical Installation Standard"

3. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

4. SITE PREPARATION

4.1 General

4.1.1 Before the DCS 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 DCS 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 DCS and it's 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 and trays containing the DCS 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 18 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 must meet intrinsically safe standard as described in ISA RP 12.6 or the field instruments and pertinent wiring shall be executed of explosion-proof type.

5.2.2 Barrier grounds for intrinsically safe system must be tied directly to instrument earth ground, in a redundant arrangement.

5.3 I/O Wiring and Cabling

5.3.1 All I/O wires and terminals shall be clearly labeled. The labels must 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.

5.4 Requirements for Power Distribution System

5.4.1 The foremost requirement of any power distribution is safety. The system must 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 DCS enclosures as indicated on the pertinent drawings. The contractor shall allow approximately 1.5 meter extra length of cable at the power distribution panel end of the power cable and 2 meter at the DCS 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.

5.4.5 The Contractor shall provide all power facilities for DCS, including; power distribution panel, circuits, cables, connection equipment and safety devices at the installation site. These facilities must conform to the requirements of the DCS Vendor. A dedicated power facility shall be provided for the DCS equipment.

6. INSTALLATION OF DCS 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 setforth in Vendor's documents.

6.1.2 DCS 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 DCS 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 literature 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 DCS 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.