IHRDC

READING DRAWINGS PFD'S AND P&ID'S

Technical Training Program
For
Existing Production Operators
And
Senior Production Operators

Total Pages (66)

Reading Drawings PFD and P&ID

Graduate Development Programme **Module (P-01) 2D**

- ***This module is designed for AFPC existing Production, Mechanical and Instrument graduates, to become familiar with PFD and P&ID drawings. They will be asked to design and sketch a simple control instrumentation for process equipment***

- ***The module covers PFD, P&ID and ISA symbols. It also includes Instrument Line Symbols/Identification and special abbreviations.***

- ***Introduction to PFD, P&ID and ISA .***
- ***PFDs***
- ***P&IDs***
- ***Instrument line symbols and identification***
- ***Special Abbreviations***
- ***Design and sketch a simple P&ID.***

Audience	**:**	**Production Operators, Senior Operators Mechanical and Instrument Technicians & Senior Technicians**
Prerequisites	**:**	**English comprehension and communication.**
Location	**:**	**AFPC Training Center, D. Z.**
Format	**:**	**Lecture, discussion and workshop practices.**

This module is one of twenty modules, which together cover the theoretical aspect of the Technical Training for the AFPC Production Graduates Development Programme. This programme has been developed specifically for AFPC Graduate Development to enhance the dynamic Nationalisation drive adopted by the company

COURSE CONTENTS:

1. Objectives
2. Course Outlines
3. Equipment / Resources
4. Course Manual (Handed out for the Participants)
5. Training Aids
6. Lesson Plan
7. Course Final Test and Model Answers
8. Appendix

1. COURSE OBJECTIVES:

Upon completion of the course, the trainee will be able to:

- Identify the different types of flow schemes.
- Identify the information in the different types of flow schemes.
- Identify the functions of individual schemes.
- Understand the symbols and abbreviations relevant to the flow schemes.
- Understand the instrument identification.
- Design and sketch simple control instrumentation for process equipment and include standard drafting symbols.

2.COURSE OUTLINES:

The course is designed for the AFPC existing production operators and senior production operators to provide the basic necessary knowledge and to gain experience dealing with reading engineering drawing special for PFD's and P & ID's

- Duration of this course is two working days (12 Hrs.).
- The maximum number of participants shall be four (4) trainees in one patch.
- This course will be conducted at AFPC Training Centre classroom in D.Z
- Course time plan shall be as follows:
  - Instruction time : 10 Hrs.
  - Test Time : 2 Hrs.
- Course program shall be proceeded as follows:

First Day (6.00 Hrs.)

Time (Hrs. / Min.)	Activity	Location
5.00	- Introduction - Flow schemes. - Instrument line symbols	Classroom
1.00	Pre- Assessment	Classroom

Second Day (6.00 Hrs.)

Time (Hrs. / Min.)	Activity	Location
5.00	• Instrument identification • Functional designation of relay • Special abbreviations • ISA symbols	Classroom
1.00	Final Test	Classroom

3. EQUIPMENT / RESOURCES TO CONDUCT THE COURSE:

The following training resources to be available in the Training Centre before conducting this course:

- Overhead Projector
- Transparencies

4.COURSE MANUAL

(HAND OUT TO THE PARTICIPANTS)

Table of Contents

1. Introduction.
2. Flow Schemes.
   2.1 Types of schemes with definitions.
   2.2 Functions of the individual schemes.
3. Instrument Line Symbols.
4. Instrument Identification.
5. Functional Designation of Relays.
6. Special Abbreviations.
7. General Abbreviations.
8. ISA Symbols.

1. INTRODUCTION:

Every scientific and technical field develops a specialized language convey information and ideas.

The specialized language not only includes particular meanings for words, it also includes abbreviations and symbols peculiar to a given field.

Anyone who seeks training in such a technical or scientific field must become familiar with the specialized language of that field.

The instrument Society of America has prepared a standard, entitled Instrumentation, Symbols and Identification, ISA- S5.1, for individuals in the field of instrumentation.

The purpose of this standard is to provide a satisfactory system of symbols and identification for industrial process instrumentation equipment.

This is designed to prompt a uniformity of practice and expedite communication in the fields of production operation and instrumentation.

2. FLOW SCHEMES

2.1Types of Scheme with Definitions

2.1.1 Process Flow Diagram (PFD)

A PFD is a simplified flow diagram of either a single process unit, a utility unit, a complete process module or an offsite product storage and loading system.

The purpose of a PFD is to provide a preliminary understanding of the process system indicating only the main items of equipment, the main pipelines and the essential instruments, switches and control valves.

A PFD also indicates operating variables, such as mass flow, temperatures and pressures, which are tabulated at various points in the system. The general symbol function letter of the instrument and a basic control valve symbol are indicated.

Explanatory notes are often included at the bottom of the PFD and these give valuable information on the different modes of operation and interment control of a process unit during the start-up and normal operating phases.

The PFD is a document containing information on:

- Process conditions and physical data of the main process streams.
- Main process equipment with design data.
- Main Process lines.
- Main controls.
- Mass (material) balance.
- Heat balance (if applicable).

2.1.2 Piping and Instrumentation Diagram (P & ID)

A P & ID is a detailed flow diagram o either a process unit, a utility unit, an ancillary unit, an offsite product storage system, a product loading system, or a drawing of a process and instrumentation system which connects different operating facilities together.

A P&ID's drawing typically provides the following detailed information:-

Mechanical Details

- **Stationary Equipment:**
  Stationary equipment such as inlet, outlet, drain, vent, instrument connections and valve connections with the associated block valves and spading points.

- **Fittings:**
  All internal fittings, access manways, support structures, materials of construction and insulation details.

- **Lube Oil and Sealing Systems;**
  Some mechanical details of rotating equipment together with their auxiliary systems (lubrication and sealing systems).

- **Piping Details:**
  Piping sizes and details such as flanges, reducers, valving, materials of construction, insulation, high point vents and low point drains.

Instrument Details

- **Symbols and Tag Numbers:**
  Measuring instrument symbols, tag numbers and locations of connections to piping or to equipment.

- **Control Device Symbols:**
  Control valve symbols or other control device symbols with their associated block valves, drain points, purge points, actuator symbols, limit switch symbols and alarm instrument symbols.

- **Signal Transmission Lines:**
  Signal transmission lines between measuring instruments and their controlling devices or control valves. Solenoid valves or other signal switching devices are shown in the transmission lines.

- **Locations:**
  Symbols and locations of instruments connected to process computers.

- **Alarms and Trips:**
  Alarm and trip instrument symbols with transmission signal lines to the appropriate shutdown devices or shutdown logic a systems.

- **Shutdown Devices:**
  Emergency system instrumentation symbols showing details of hydraulic/ pneumatic actuators used with different types of valves.

Each P&ID's drawing contains a list of explanatory notes which supplement or clarify the graphical details shown on the P&ID's. This additional information covers special features of the stationary equipment, rotating equipment or instrumentation. For example, explanatory notes about complex process control loops, compressor anti-surge control loops and furnace logic systems for star-up and shutdown or the emergency alarm an be shown on a P&ID's.

2.1.3 Process Engineering Utility Flow Diagram (PEUFD)

The PEFD is a document containing information on:

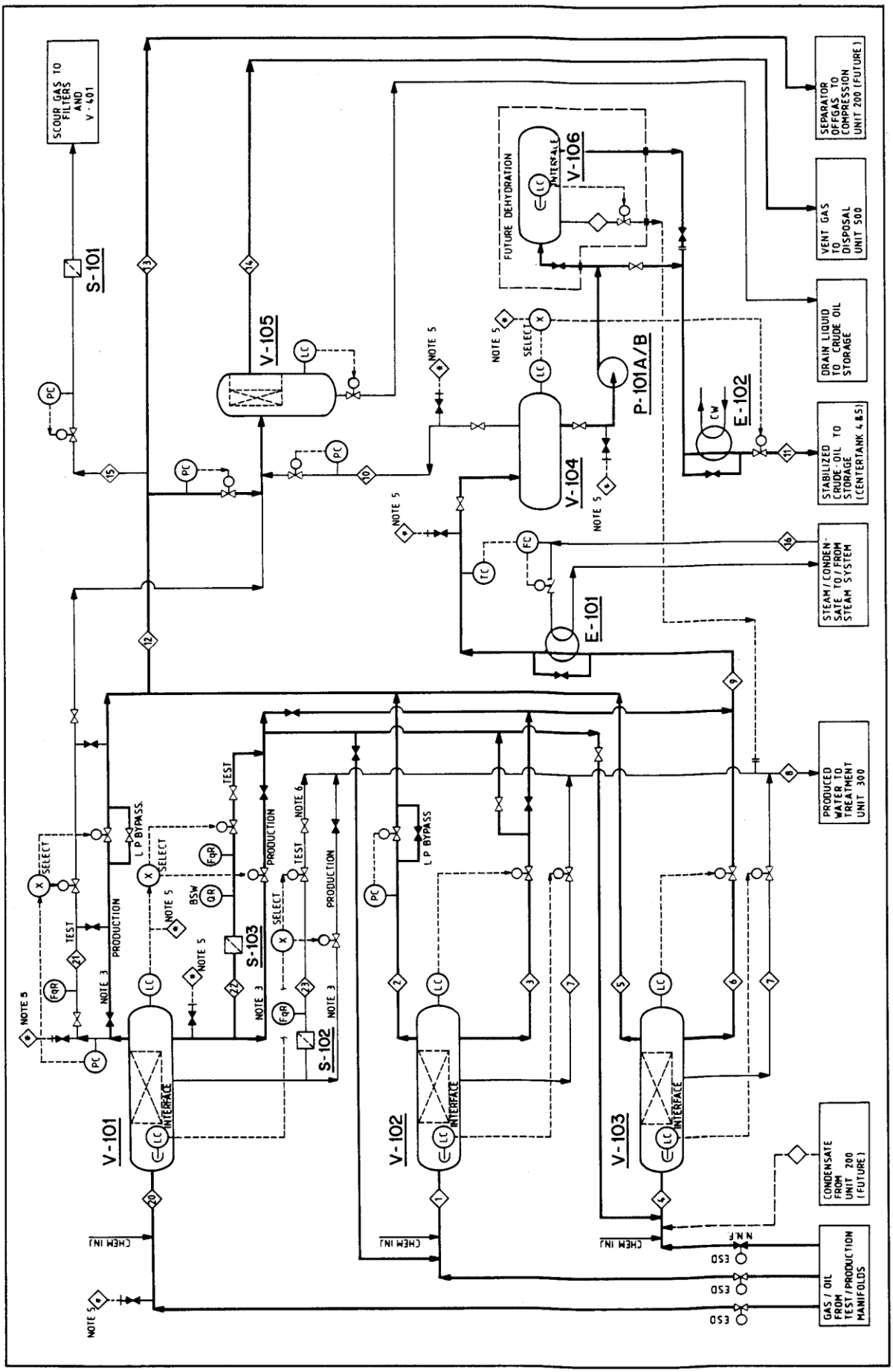
- Main distortion and/or collection arrangement of each individual utility system, expect electrical systems. Detailed design/ engineering data are given as on the P&ID mentioned above. In addition the PEUFD shows the mass and heat balances of the system concerned.

Note: The PEUFD is usually the first schematic document prepared for a certain utility. Only for very large utility systems is a Process Utility Flow Diagram (PUFD) prepared first.

2.1.4 Process Safeguarding Flow Diagram (PSFD)

The PSFD is a document highlighting information on:

- Types and levels of protection offered by the devices installed and their inter relation to demonstrate the plant's safety.


SCOUR GAS TO FILTERS AND V-401
S-101
V-105
V-106
FUTURE DEHYDRATION
INTERFACE
SEPARATOR OFFGAS TO COMPRESSION UNIT 200 (FUTURE)
VENT GAS TO DISPOSAL UNIT 500
DRAIN LIQUID TO CRUDE OIL STORAGE
P-101A/B
E-102
CW
V-104
STABILIZED CRUDE OIL TO STORAGE (CENTERTANK 4&5)
STEAM/CONDENSATE TO/FROM STEAM SYSTEM
E-101
PRODUCED WATER TO TREATMENT UNIT 300
L P BYPASS
TEST
PRODUCTION
SELECT
NOTE 5
NOTE 3
NOTE 6
S-103
S-102
V-101
V-102
V-103
CONDENSATE FROM UNIT 200 (FUTURE)
GAS / OIL FROM TEST / PRODUCTION MANIFOLDS
CHEM INJ
ESD

EQUIPMENT	V-101 HP/LP TEST PRODUCTION SEPARATOR	V-102 HP/LP PRODUCTION SEPARATOR	V-103 LP PRODUCTION SEPARATOR	V-104 CRUDE OIL STABILIZER VESSEL	V-105 VENT GAS SCRUBBER	V-106 CRUDE OIL DEHYDRATOR (FUTURE)	S-101 SCOUR GASFILTER	S-102/103 INLINE STRAINERS
I.D. x LENGTH mm	2500 x 7500	2500 x 7500	2500 x 7500	1800 x 7200	1370 x 4980	3400 x 14600	273 x 2540	3/4" NOMINAL
VOLUME m^3	39.5	39.5	39.5	19.8	8.0	142	-	NIL
TYPE / MAKE	B.S & B	B.S & B	B.S & B	KUNZEL	PORTATEST	- NOTE 7	75V-2-flt 324 PECO	DUPLEX/PLENTY

EQUIPMENT	E-101 CRUDE OIL PREHEATER	E-102 STABILIZED CRUDE OIL COOLER
DUTY (DESIGN) kW	4440	1045
DUTY (NORM) kW	1370	1045
TYPE / MAKE	KORPERSHOEK	KORPERSHOEK

EQUIPMENT	P-101 A/B STABILIZED CRUDE OIL PUMPS
CAPACITY m^3/h	150
HEAD, m LIQ	23
BEGEMAN	BS-R-50F-1

7. PRELIMINARY DIMENSIONS FOR LAYOUT ONLY
8. DESIGN FLOW RATE

NOTES : 1. PRE-CHOKE CONDITIONS :
PRESSURE : 21 bar (ga)
TEMPERATURE : 45 °C

2. NORMALLY NO FLOW, DATA GIVEN ARE FOR LINESIZING ONLY, BASED ON 60% FREE WATER AT 3000 m^3/d

3. DESIGNED FOR PRODUCTION FLOW (SPARE OPERATION)

4. WATER FLOW AT TEST-OPERATION : 60% AT MAX. 950 m^3/d FOR DESIGN PURPOSE

5. ◈ INDICATES CONNECTIONS FOR TEST SEPARATOR IN SPARE STABILIZER MODE

6. WATER DRAW-OFF TO BE ROUTED TO WING-TANKS. No.3 SEPARATELY FOR FLUSHING OPERATIONS.

OPERATION													
STREAM	①		②	③	④		⑤	⑥	⑦	⑧	⑨	
PHASE	VAP	LIQ	VAP	LIQ	VAP	LIQ	VAP	LIQ	LIQ	LIQ	VAP	LIQ
t/d	644.5	2904.7	644.5	2904.7	67.4	2837.3	67.4	2837.3	1996	1996	6.9	2830.4
kg/s	7.46	33.62	7.46	33.62	0.78	32.84	0.78	32.84	23.1	23.1	0.08	32.76
*) D 15/4 OR M W	42.7	0.900	42.7	0.900	43.7	0.900	43.7	0.900	1045	1045	44.1	0.900
DENSITY ACT. kg/m^3	23.8	880	23.8	880	5.86	880	5.86	880	1035	1035	4.1	880
VISCOSITY mm^2/s	-	1.6	-	1.6	-	1.6		1.6	-	-		1.6
PRESSURE bar (ga)	12.8		12.8	12.8	2.5		2.5	2.5	12.8/2.45	0.05	1.4	
TEMPERATURE °C	43		43	43	41		41	41	43	43	41	

NOTE 1 NOTE 2

OPERATION							
STREAM	⑩	⑪	⑫	⑬	⑭	⑮ *	⑯
PHASE	VAP	LIQ	VAP	VAP	VAP	VAP	STEAM
t/d	17.3	2820	711.9	NNF	729.2	17.3	57.0
kg/s	0.20	32.64	8.24	-	8.44	0.2	0.66
*) D 15/4 OR M W	46.2	0.900	42.8	42.8	42.9	42.8	18
DENSITY ACT. kg/m^3	2.35	875	5.6	5.8	2.0	5.8	4.1
VISCOSITY mm^2/s	-	1.5	-	-	-	-	-
PRESSURE bar (ga)	0.4	0.05	2.45	2.45	0.2	2.45	7.0
TEMPERATURE °C	60	45	34	34	33	34	170

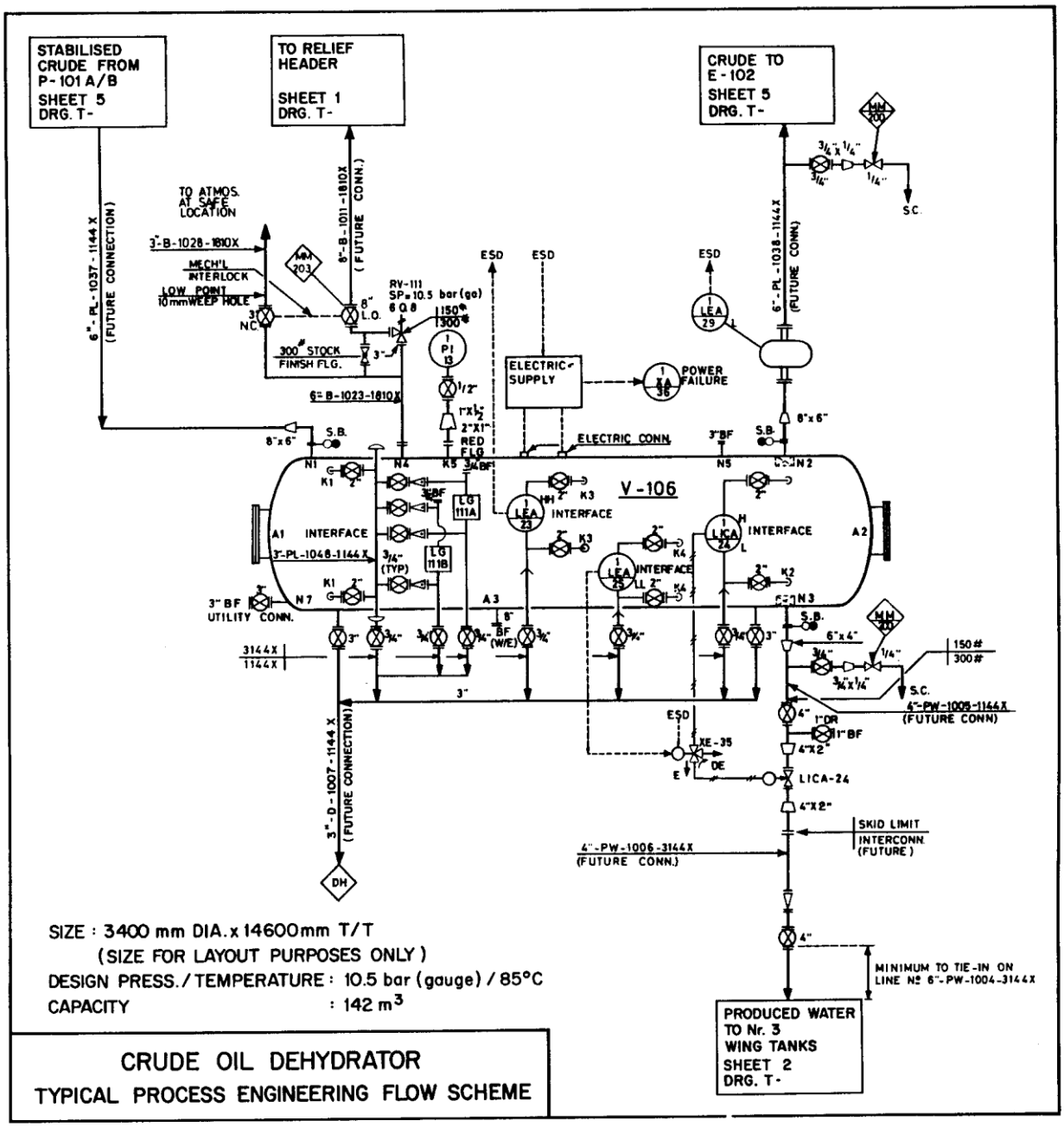
*) DENSITY 15 °C / 4 °C
MW NOW CALLED RELATIVE MOLECULAR MASS

* NOTE 8

TEST OPERATION (V-101)				
⑳		㉑	㉒	㉓
VAP	LIQ	VAP	LIQ	LIQ
1900	858.2	190	858.2	598.0
2.20	9.93	2.20	9.93	6.92
42.7	0.900	42.7	0.900	1.045
23.8	880	23.8	880	1035
-	1.6	-	1.6	-
12.8		12.8	12.8	12.8
43		43	43	43

NOTE 4

GAS / OIL SEPARATION
TYPICAL PROCESS FLOW SCHEME


STABILISED CRUDE FROM P-101 A/B SHEET 5 DRG. T-
TO RELIEF HEADER SHEET 1 DRG. T-
CRUDE TO E-102 SHEET 5 DRG. T-
TO ATMOS. AT SAFE LOCATION
3"-B-1028-1810X
MECH'L INTERLOCK
LOW POINT 10mm WEEP HOLE
8"-B-1011-1810X (FUTURE CONN.)
6"-PL-1037-1144X (FUTURE CONNECTION)
6"-PL-1038-1144X (FUTURE CONN)
RV-111 SP=10.5 bar(ga)
300# STOCK FINISH FLG.
6"-B-1023-1810X
ESD
ELECTRIC SUPPLY
POWER FAILURE
ELECTRIC CONN.
V-106
INTERFACE
3"-PL-1048-1144X
3" BF UTILITY CONN.
3144X
1144X
3"-D-1007-1144X (FUTURE CONNECTION)
DH
4"-PW-1005-1144X (FUTURE CONN)
LICA-24
SKID LIMIT
INTERCONN. (FUTURE)
4"-PW-1006-3144X (FUTURE CONN.)
MINIMUM TO TIE-IN ON LINE Nº 6"-PW-1004-3144X
PRODUCED WATER TO Nr. 3 WING TANKS SHEET 2 DRG. T-
SIZE : 3400 mm DIA. x 14600mm T/T
(SIZE FOR LAYOUT PURPOSES ONLY)
DESIGN PRESS./TEMPERATURE : 10.5 bar (gauge) / 85°C
CAPACITY : 142 m³
CRUDE OIL DEHYDRATOR
TYPICAL PROCESS ENGINEERING FLOW SCHEME

2. 2 Functions of the Individual Schemes

2.2.1 Process Flow Diagram (PFD)

The PFD stating process conditions and physical data for design conditions shall serve as a basis for:

- Advanced ordering of special/long delivery equipment/materials base the
- on the Preliminary Project Planning
- Obtaining a preliminary equipment summary list
- Composing preliminary plant layout
- Preparing preliminary cost estimate (25-40% accuracy)
- Preparation of the MID with data sheets.
- Preliminary risk analysis.

2.2.2 Piping and instrumentation diagram (P&ID)

The P&ID based on the PFD shall contain detailed information (sizing and specification) required for engineering purposes and serve as a basis for:

- Planning schedule
- Final plant layout development together with hazardous areas classification
- Preparing piping, instrument, safety relief valve and level gauge data sheets
- Construction contract specifications
- Developing piping layout drawings
- Bulk material ordering (piping, electrical, instrumentation, civil)
- Remaining equipment ordering
- Final capital cost estimate (engineering, purchasing and construction) 10% accuracy
- HAZOP studies/safety reviews
- Operations review
- Stating special requirements for start-up and shut-down

2.2.3 Process Engineering Utility Flow diagram (PEUFD)

The PEUFD shall state characteristics and consumption figures of the particular utility concerned, cooling water, fire water, drinking water, steam, plant air, instrument air, fuel oil/gas, inert gas and similar utilities. When serving different processing plants isolating facilities are to be provided for each process plant.

The basic use of the PEUFD follows the general principles and details as described for the P&ID above.

For an electrical utility system the electrical engineer prepares an electrical key diagram and electrical load summary sheets. In principle these documents serve the same purpose as the PEUFDs.

2.2.4 Process Safeguarding Flow Diagram (PSFD)

The PSFD shall state in detail identification and clarification of the essential detecting devices and their relation to one another, as well as the related emergency shut-down facilities.

The P&ID contains all information required for a PSFD; however, the PSFD highlights protection in case of extreme conditions and measures to be taken to safeguard personnel and environment.

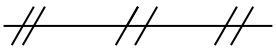
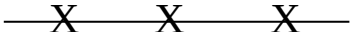
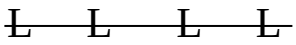
Note: In general these schemes will only be made for complex installations like offshore process platforms. For simple applications the information shown on the P&ID is usually sufficient to highlight safety devices and aspects.

3. INSTRUMENT LINE SYMBOLS.

For instrumentation, there are six line designations that are commonly used. These are shown in Table 1:

Table 1

Instrument Line Symbols

All lines shall be fine in relation to process piping lines.	
(1) Connection to process, or mechanical link. or instrument supply	
(2) Pneumatic signal, or undefined signal for process flow diagrams	
(3) Electric signal	
(4) Capillary tubing (filled system)	
(5) Hydraulic signal	
(6) Electromagnetic or sonic signal (without wiring or tubing)	

Notes

- The following abbreviations are suggested to denote the types or power supply. These designation may also be applied for purge fluid supplies.

AS	Air Supply.
ES	Electric Supply.
GS	Gas Supply.
HS	Hydraulic Supply.
NS	Nitrogen Supply.
SS	Steam Supply.
WS	Water Supply.

- The power supply level may be added to the instrument supply line, e.g., AS 100, a100-psig air supply; ES 2413C, a 24- volt direct current supply.

- The pneumatic signal symbol applies to a signal using any gas as the signal medium. If a gas other than air is used, the gas shall be identified by a note on the signal symbol or otherwise

- Electromagnetic phenomena include heat, radio waves, nuclear radiation, and light.

4. INSTRUMENT IDENTIFICATION

Instruments are identified by a system of letters and numbers as shown in Table - 2 The number is generally common to all instrument of the loop of which it is a part.

Table-2

T	**RC**	**-2**	**A**
First letter	Succeeding Letters	Loop Number	Suffix
Functional Identification		Loop Identification	
Instrument Identification or / Tag Number			

The first two letters identify the function of the instrument and are selected from I Table 3 . The succeeding numbers and letters identify the particular loop.

'The first letter designates the measured or initiating variable such as temperature, level, flow, etc. Modifying letters such as D for differential, F for ratio, and Q for totalizing may follow the first Letter. For example , a TDI a differential temperature indicator and a FQR is a flow recorder with an integrator in the loop.

The succeeding letters designate one or more functions of the loop such as readout, passive function, or output.

The loop identification method assigns a number to each loop. It may begin with 1, 20 1, or 120 1, which may include a plant area coding system.

Prefix numbers may be assigned to a number to designate plant areas. For example, 6-TRC-2 may indicate an instrument located in Plant Area 6.

If an instrument is common to more than a loop it may be assigned a separate number.

For loops that have more than one instrument with the same functional identification, suffixes should be added to the loop number; e.g., FV-2A
FV-213, etc., or TE-25- 1, TE-25-2, TE-25-3, etc.

Table 3

Meaning Of Identification Letters

This table applies only to the functional identification of instruments Numbers in table refer to notes following.

	First letter			Succeeding Letters (3)		
	Measured or Initiating Variables (4)	**Modifier**		**Readout or Passive Function**	**Output Function**	**Modifier**
A	Analysis (5)			Alarm		
B	Burner Flame			User's Choice (1)	User's Choice(1)	User's Choice (1)
C	Conductivity (Electrical)				Control (13)	
D	Density (Mass) or Specific Gravity	Differential (4)				
E	Voltage (EMF)			Primary Element		
F	Flow Rate	Ratio (Fraction) (4)				
G	Gauging (Dimensional)			Glass (9)		
H	Hand (Manually Initiated)					High (7,15,16)
I	Current (Electrical)			Indicate (10)		
J	Power	Scan (7)				
K	Time or Time-Schedule				Control Station	
L	Level			Light (Pilot) (11)		Low (7,15,16)
M	Moisture or Humidity					Middle or Intermediate (7,15)
N (1)	User's Choice			User's Choice	User's Choice	User's Choice
O	User's Choice (1)			Orifice (Restriction)		
P	Pressure or Vacuum			Point (Test Connection)		
Q	Quantify or Event	Integrate Totalize (4)				
R	Radioactivity			Record or Print		
S	Sped or frequency	Safety (8)			Switch (13)	
T	Temperature				Transmit	
U	Multivariable (6)			Multifunction (12)	Multifunction (12)	Multifunction (12)
V	Viscosity				Valve, damper, or, Louver (13)	
W	Weight or force			Well		
X (2)	Unclassified			Unclassified	Unclassified	Unclassified
Y	User's Choice (1)				Relay or Compute (13,14)	
Z	Position				Drive, Actuate or Unclassified Final Control Element	

Notes For Table 3
Meanings Of Identification Letters

1- A user's choice letter is intended to cover unlisted meanings that will be used repetitively in a particular project. If used, the letter may have meaning as a first-letter and another meaning as a succeeding letter.
The meanings need be defined only once in a legend, or otherwise, for that project. For example, the letter N may be defined as module of elasticity as a first-letter and oscilloscope as a succeeding-letter.

2- The unclassified letter X, is intended to cover unlisted meanings that will be used only once or to a limited extent. If used, the letter may have any number of meanings as a first letter and any number of meanings as a succeeding letter. Except for its use with distinctive symbols it is expected that the meanings will be defined outside a tagging balloon on flow diagram. For example, XR-2 may be a stress recorder, XR-3 may be a vibration recorder, and XX-4 may be a stress oscilloscope.

3- The grammatical form of the succeeding-letter meanings may be modified as required. For example, indicate may be applied as indicator or indicating, transmit as transmitter or transmitting, etc.

4- Any first-letter, if used in combination with modifying letter D (differential), F (ratio), or Q (integrate or totalize), or any combination of them, shall be construed to represent a new and separate measured variable, and the combination shall be treated as a first- letter entity.
Thus, instruments TDI and TI measure two different variables, differential-temperature and temperature. These modifying letter shall be used when applicable.

5- Fist-letter A for analysis covers all analyses that are not listed in Table 3 and are not covered by a user's choice letter. It is expected that the type of analysis in each instance will be defined outside a tagging balloon on flow diagram.

6- Use of first-letter U for multiple in lieu of a combination of first-letter is optional.

7- The use of modifying terms high, low, or intermediate, and scan is preferred, but optional.

8- The term safety shall apply only to emergency protective primary elements and emergency protective final control elements. Thus, a self-actuated valve that prevents operation of a fluid system at a higher-than-de sired pressure by bleeding fluid from the system shall be a back pressure- type PCV, even if the valve were not intended to be used normally. However, this valve shall be a PSV if it were

intended to protect against emergency conditions- i.e., conditions that are hazardous to personnel or equipment, or both, and that are not expected to arise normally.

The designation PSV applies to all valves intended to protect against emergency pressure conditions regardless of whether the valve construction and more of operation place them in the category of the safety valve, or safety-relief valve.

9- Passive function glass applies to instruments that provide an uncelebrated direct view of the process.

10- The term indicate applies only to the readout of an actual measurement. It does not apply to a scale for manual adjustment of a variable if there is no measurement input to the scale.

11- A pilot light that is part of an instrument loop shall be designated by a first1 letter followed by succeeding-letter L. For example, a pilot light that indicates an expired time period may be tagged KL A running light for an electric motor may be tagged either EL, assuming that voltage is the appropriate measured variable, or XL, assuming that the light is actuated by auxiliary electric contacts of the motor starter, or simply L.
The action of a pilot light may be accompanied by an audible signal.

12- Use of succeeding-letter U for multifunction instead of a combination of other functional letters is optional.

13- A device that connects, disconnects, or transfers one or more circuits may be either a switch, a relay, an on-off control valve, depending on the application.

If the device manipulates a fluid process steam and is not a hand-Actuated On-off block valve, it shall be designated as a control valve. For all applications other than fluid process streams, the device shall be designated as follows:

A switch, if it is actuated by hand.
A switch or an on-off controller if it is automatic and is the first such device in a loop.

The term switch is generally used if the device is used for alarm, pilot light, selection, interlock, or safety. The term controller is generally used if the device is used for normal operating control. A relay, if it is automatic and is not the first such device in a loop, I . e., it is actuated by a switch or an on-off controller.

14- It is expected that the functions associated with the use of succeeding-letter Y will be defined outside a balloon on a flow diagram when it is convenient to do so.

15- Use of modifying terms high, and middle or intermediate shall correspond to values of the measured variable, not of the signal, unless otherwise noted. For example, a high-level alarm derived from a reverse-acting level transmitter signal shall be an LAH even though the alarm is actuated when the signal falls to a low value. The terms may be used in combinations as appropriate.

16-The terms high and low, when applied to positions of valves and other open-close devices, are defined as follows; high denotes that valve is in or approaching the fully open position, and low denotes in or approaching the fully closed position.

5. FUNCTIONAL DESIGNATION OF RELAYS

Table 4

The function designations associated with relays may be used as follows individually or in combination (see Table 3, note 14) The use of a box enclosing a symbol is optional; the box is intended to avoid confusion by setting off the symbol from other markings on a diagram.

Symbol	Function
1. 1.0 or ON-OFF	Automatically connect. disconnect. or transfer one or more circuit.... provided that this is not the first such device in a loop (see Table 3 note 13).
2. V or ADD	Add or totalize (add and subtract)f
3△ or DIFF.	Subtract
4. ±	
+	Bias*
-	
5. AVG.	Average
6.% or 1:3 or 2:1 (typical)	Gain or attenuate (input: output)*
7. ⊠	Multiply +
8. ÷	Divide +
9. √ or SQ. RT.	Extract square root
10. X^n or $X^{1/n}$	Raise to power
11. f (X)	Characterize
12. 1:1	Boost
1.3. > OR Highest (MEASURED VARIABLE)	High-select. Select highest (higher) measured variable (not signal. unless so noted).
14. < OR LOWEST (MEASURED VARIABLE)	Low-select. Select lowest (lower) measured variable (not signal. unless so noted).
15. REV.	Reverse
16.	Convert
a. E/P or P/I (typical)	For input/ output sequences of the following: Designation — Signal E — Voltage H — Hydraulic I — Current (electrical) O — electromagnetic or sonic P — Pneumatic R — Resistance (electrical)
b. A/D or D/A	For input/ output sequences of the following: A — Analog D — Digital
17.	Integrate (time Integral)
18. D or d/dt	Derivative or rate
19. 1/D	Inverse derivative
20. As required	Unclassified

* Used for single-input relay.
\+ Used for relay with two or more inputs.

6. SPECIAL ABBREVIATIONS

Table 5

For abbreviations other than instrument identification letters of Table 3

Abbreviation	Meaning
A	Analog signal
ADAPT,	Adaptive control mode
AS	Air supply
AM	Average
C	Patch board or matrix board connection
D	Derivative control mode Digital signal
DIFF.	Subtract
DIR.	Direct-acting
E	Voltage signal
ES	Electric supply
FC	Fail closed
F1	Fail indeterminate
FL	Fail locked
FO	Fail open
GS	Gas supply
H	Hydraulic signal
HS	Hydraulic supply
1	Current (electrical) signal Interlock
M	Motor actuator
MAX	Maximizing control mode
MIN,	Minimizing control mode
NS	Nitrogen supply
O	Electromagnetic or sonic signal
OPT.	Optimizing control mode.
p	Pneumatic signal proportional control mode Purge or flushing device
R	Automatic- reset control mode Reset of fail-locked device Resistance (signal)
REV.	Reverse acting
RTD	Resistance (-type) temperature detector
S	Solenoid actuator
S.P.	Set point
SQ.RT.	Square root
SS	Steam supply
T	Trap
WS	Water supply
X	Multiply Unclassified actuator

7. GENERAL ABBREVIATIONS

A/D	Analog to digital
AE	Analyser element
AI	Analyser indicator
AT	Analyser transmitter
ASH	Analyser switch high
AM	Analyser alarm high
AO	Air to open
AC	Air to close
AFO	Air failure open
AFC	Air failure close
AOV	Air operated valve
AY	Electrical relay
BE	Burner flame element
BAO	Burner alarm off
BFO	Burner flame off
BAL	Burner alarm low
BSI,	Burner switch low
BS&W	Base sediment & water
BOH	Blow out hatch
B	Building
BF	Blind flange
CVA	Choke valve, adjustable
CVC	Choke valve control
CVP	Choke valve positive
CCH	Central control house
CCP	Central control panel
CC	Corrosion coupon
CP	Corrosion probe control
CSO	Car seal open
CSC	Car seal closed
CD	Continuos drainer
CO	Clean out
W	Choke nipple
c	Compressor
CTC	Central telemetry
D	Dryer
DA	Direct acting
DPSW	Differential pressure switch
DE	Density element
DR	Density recorder
E	Exchanger
EI	Voltage indicator
ESD	Emergency shutdown
FA	Flow alarm
FAH	Flow alarm high
FAL	Flow alarm low
FC	Flow controller
FCV	Flow control valve
FI	Flow indicator
FE	Flow element
FR	Flow recorder
FT	Flow transmitter
FV	Flow valve
FS	Flow switch
FSH	Flow switch high
FSI,	Flow switch low
FRC	Flow recorder controller
FXR	Flow data logger
FC	Fail close
FIC	Flow indicating controller
FYL	Flow relay low
FY	Flow relay
FQI	Flow totaliser
FQXR	Flow totaliser data logger
FIS	Flow indicating switch
FTPR	Flow recorder (3)
FrRC	Flow ratio controller
FFY	Signal multiplier
FOT	Flat on top
FA	Flame arrestor
F	Filter
GAI	Gas analyser indicator
GA	Gas analyser
G	Generator

H	Heater
HY	Hydrant
H2AH	Hydrogen alarm high
H2AL	Hydrogen alarm low
H2T	Hydrogen transmitter
H2S	Hydrogen suphide
IAS	Instrument air supply
ILG	Interface level gauge
ILC	Interface level control
ILCV	Interface level control valve
ILT	Interface level transmitter
ILIC	Interface level indicating controller
I/P	Current to pneumatic transmitter
I/S	Current to switch transducer
KC	Time controller
LA	Level alarm
LAH	Level alarm high
LAL	Level alarm low
LAHL	Level alarm high low
LCV	Level control valve
LV	Level valve
LS	Level switch
LSHL	Level switch high low
LSH	Level switch high
LSI,	Level switch low
LXR	Level data logger
MA	Moisture analyser
MAA	Moisture analyser alarm
MCC	Motor control centre
MLS	Motor loading station
MOV	Motor operated valve
MSS	Manual selector station
MS	Manual set point station
MO	Manually operated
MT	Moisture transmitter
NC	Normally closed
NO	Normally open
PA	Pressure alarm
PAL	Pressure alarm low
PAH	Pressure alarm high
PI	Pressure indicator
PIC	Pressure indicating controller
HE	Heater element
HOA	Hand-Off-Auto
HS	Hand switch
HCV	Hand control valve
IT	Current indicator
LI	Level indicator
LC	Level controller
LG	Level gauge
LR	Level recorder
LRC	Level recorder controller
LIC	Level indicating controller
LT	Level transmitter
LY	Level relay
L	Launcher
MR	Meter
M/A	Manual-Auto alarm
MCVI	Motor controlled valve indicator
MW	Man-way
MX	Mixer
MOL	Main line oil
MR	Manual reset
NOC	Net oil computer
PCV	Pressure control valve
PC	Pressure controller
PR	Pressure recorder
PRC	Pressure recorder controller

Abbreviations (Continued)

PV	Pressure	valve	PY	Pressure	relay
PS	Pressure	switch	PYH	Pressure	relay high
PSL	Pressure	switch low	PYL	Pressure	relay low
PSH	Pressure	switch high	PSV	Pressure	safety

PSHL Pressure switch high low valve
PXR Pressure data logger
PDI Pressure differential indicator
PDSI, Pressure differential switch low
PDSH Pressure differential switch high
PDC Pressure differential controller
PDT Pressure differential transmitter
PDIC Pressure differential indicator controller
PDCV Pressure differential control valve
P/I Pneumatic to current transducer
P/E Pneumatic to electric transducer

QC Quality control
QCA Quality control alarm
QCI Quality control indicator

RA	Reverse acting	RM	Remote manifold
RD	Rupture disc	RTS	Remote test station
RO	Restriction orifice	RTU	Remote terminal unit
RB	Reduced bore		
RTD	Resistance temperature detector		
SC	Speed controller	SDY	Solenoid valve
SS	Speed switch	SD	Shutdown
SI	Speed indicator	SDP	Shutdown panel
ST	Speed transmitter	SDV	Shutdown valve
SR	Speed recorder	STR	Strainer
SAH	Overspeed alarm	SSV	Surface safety valve
SC	Sample connection		
S	Sump		

TAH	Temperature	alarm high	TW	Thermal well
TAL	Temperature	alarm low	TV	Temperature valve
TY	Temperature	relay	TH	Thief hatch
TC	Temperature	controller	TA	Temperature alarm
TE	Temperature	element	T	Tank
TI	Temperature	indicator		
TCV	Temperature	control valve		
TIC	Temperature	controller		
TR	Temperature	recorder		
TRC	Temperature	recorder controller		
TSH	Temperature	switch high		
TSL	Temperature	switch low		
TT	Temperature	transmitter		
TXR	Temperature	data logger		

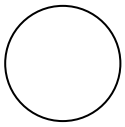
UA	Unit shutdown alarm
UC	Utility connection
VE	vibration sensor
VI	Vibration indicator
vs	Vibration switch
VSH	Vibration switch high
VAH	Vibration alarm high
VT	Vibration transmitter
WHS	Wellhead start button
UXR	Unit alarm data logger
v	Vessel
VB	Voltage balance
VR	Voltage regulator
VPSB	Vacuum pressure safety valve
WH	Wellhead

x	Electrical
XAS	Auto-select relay
xC	Converter
XCV	Deluge valve
XDI	Dewpoint indicator
XFA	Flow adder
XFrC	Flow ratio controller
XFC	Flow computer
XFT	Flow totaliser
XPSU	Power supply unit
XRG	Ramp generator
XTC	Temperature converter
XTP	Ticket printer
XVPI	Valve position indicator XXP
XVPS	Valve position switch
XA	Common alarm
XAC	Analog computer
XS	Beacon light
XBA	Beacon alarm
XCM	Corrosion meter
XCR	Control relay
XPA	Sphere detector
XSS	Sphere passage switch
XSPI	Sphere passage indicator
XI	Running light
XSRH	Selector relay high
	Pre-alarm to data logger

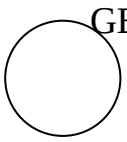
8. ISA SYMBOLS

Instruments

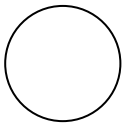
Symbols according to ITN 02912 and ISA STD VII ED. 1983 with specifications/ Exceptions as follow



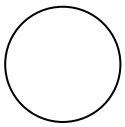
Locally mounted instrument



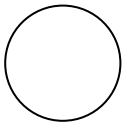
Instrument mounted on Local Gauge Board



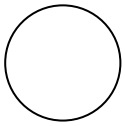
Instrument mounted on Local Board (or Local Panel)



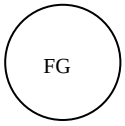
Instrument mounted on Main Board (or Main Panel)



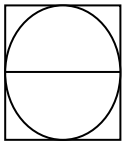
Instrument mounted on Rear local Board



Instrument mounted or Rear Main Board



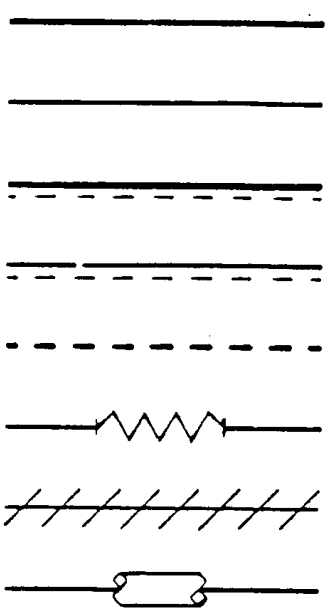
Flow sight glass.



Shared display in Control Room.

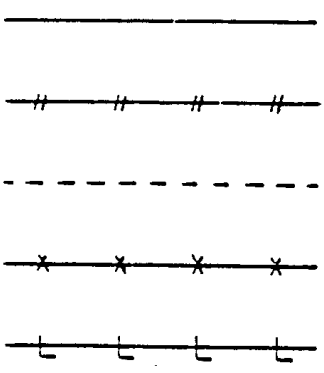
PIPELINES

SYMBOLS ACCORDING TO ITN 02912



INSTRUMENT LINES

SYMBOLS ACCORDING TO ITN 02912 AND ISA STD VII ED. 1983 PARAG. 5.1



VALVES

SYMBOLS ACCORDING TO ITN 02912 AND ISA VII ED. 1983 WITH SPECIFICATIONS / EXCEPTIONS AS FOLLOWS:


UNCLASSIFIED VALVE NORMALLY OPEN


UNCLASSIFIED VALVE NORMALLY CLOSED


GLOBE VALVE NORMALLY OPEN


GLOBE VALVE NORMALLY CLOSED


BALL VALVE NORMALLY OPEN


BALL VALVE NORMALLY CLOSED


GATE VALVE NORMALLY OPEN


GATE VALVE NORMALLY CLOSED


NEEDLE VALVE NORMALLY OPEN


NEEDLE VALVE NORMALLY CLOSED


BUTTERFLY VALVE


CHECK VALVE

3 - WAY BALL VALVE

3 - WAY VALVES WITH INTERLOCK

PRESSURE RELIEF VALVE OR SPRING
ACTUATED PRESSURE CONTROL VALVE

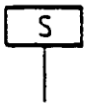
THERMOSTATIC VALVE WITH
INTERNAL SENSIBLE ELEMENT

ACTUATORS

SYMBOLS ACCORDING TO ITN 02912 AND ISA STD VII ED. 1983

DIAPHRAGM (OR GENERAL ACTUATOR)

CYLINDER

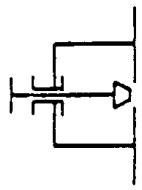


SOLENOID

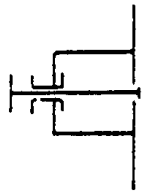
HAND

SELF CONTAINED

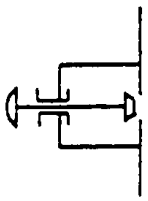
CLEARANCE POCKETS



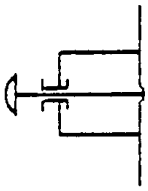
PLUG TYPE - MANUALLY OPERATED



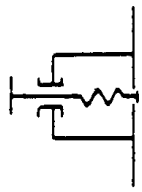
VALVE TYPE - MANUALLY OPERATED



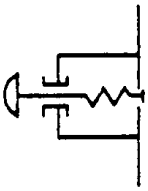
PLUG TYPE - PNEUMATICALLY OPERATED



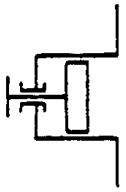
VALVE TYPE - PNEUMATICALLY OPERATED



VARIABLE TIME INSERCTION TYPE
MANUALLY OPERATED



VARIABLE TIME INSERCTION TYPE
PNEUMATICALLY OPERATED



VARIABLE VOLUME - MANUALLY OPERATED

MISCELLANEOUS

SYMBOLS ACCORDING TO ITN 02912

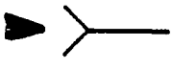
EQUIPMENT LINE

BATTERY OR SKID LIMIT

TEMPORARY STRAINER

Y-TIPE FILTER

SPECTACLE BLIND



OPEN DRAIN

CLOSED DRAIN

PLUG

CAP

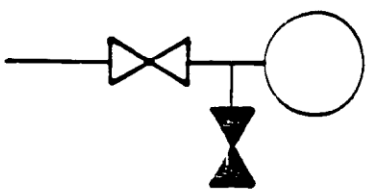
REDUCER

BREATHER

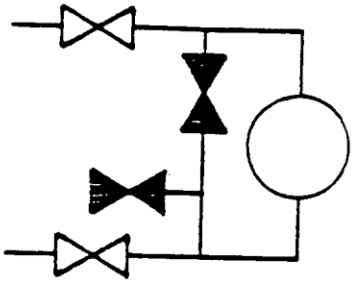
EXPLOSION RELIEF VALVE

TYPICAL ARRANGEMENT FOR INSTRUMENT CONNECTIONS

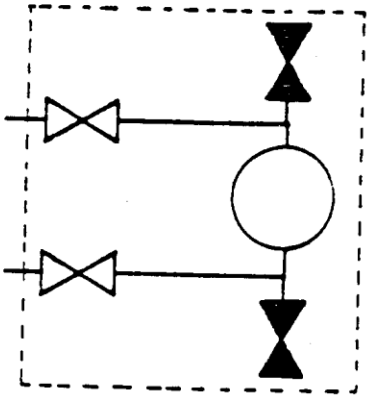
(WHEN MORE INSTRUMENTS ARE CONNECTED TO PROCESS BY A COMMON IMPULSE LINE, AN ADDITIONAL BLOCK VALVE WILL BE INSTALLED ON IT)



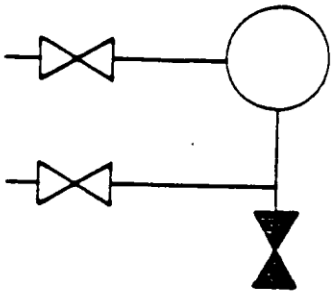
PRESSURE INSTRUMENT



DIFFERENTIAL PRESSURE INSTRUMENT



LEVEL GAUGE



LEVEL SWITCH

VALVE UNLOADERS

MANUALLY OPERATED

PNEUMATICALLY OPERATED

REVERSE FLOW TYPE - MANUALLY OPERATED

REVERSE FLOW TYPE - PNEUMATICALLY OPERATED

5. LIST OF TRANSPERANCIES

Transparencies List

Trans.	Description	Page. No.
T-1	Course Objectives.	4
T-2/ T-3	Typical Process Flow Schemes	14/15
T-4	Typical P&ID.	16
T-5	Instrument Symbols.	31
T-6	Pipelines Symbols.	32
T-7/ T-8	Valves Symbols.	33
T-9	Actuators.	34
T-10	Clearance Pockets Symbols.	35
T-11	Miscellaneous.	36
T-12	Typical Arrangement for Instrument Connection.	36

6. LESSON PLAN

Trainer to follow these instructions:

- To prompt learning, attempt to make the classroom comfortable. E.g., check the temperature, arrange so everyone can see the front, etc.)
- During the introduction, tolk to the participants.
- Gauge their Technical knowledge and ability to follow your language.
- Adjust your speed to match participants.
- Pay individual attention in classroom.
- Allow time for brief breaks at hourly internals.
- Record attendance.
- If students raise questions that don't apply to the course content, suggest that they discussion them with you during a break or after class.
- This course shall be conducted in two working days (12 Hrs). and will be performed in classroom.

Day-1, Lesson-1

(Suggested time for this section: Two hours).

Contents	Activities
1. Introduction - Introduce yourself. - Instructe the class participants. - Have one or two describe their understanding with PFD's and P&ID's.	
- Give Pre-assessment.	Have each student grade their own and pass them to you. Record the grades.
- Distribute student manual.	- Prerequisites.
- Point out the contents of the manual.	- Objectives **(Show overhead T1)** - Point out what is expected of them by reviewing the responsibility list.
	- Purpose of the manual. - Be sure to note the manual is each students copy. - Contents of the manual.

Day-1, Lesson-2

(Suggested time for this section: Two hours).

Contents	Activities
2. Types of schemes with definitions. - Point out types of schemes.	- Process flow diagram (PFD). - Piping and instrumentation diagram (P&ID). - Process engineering utility flow diagram (PEUFD). - Process safeguarding flow diagram (PSFD).
- Explain and discuss the importance of PFD and identify the information included.	- **Show overhead T2/ T3.** - Refer to student manual item 2.1.1.
- Explain and discuss the importance of P & ID and identify the information that included.	- **Show overhead T4.** - Refer to student manual item 2.1.2.
- Discuss the function of PFD.	- Refer to students manual item 2.2.1.
- Discuss the function of P&ID's.	- Refer to students manual item 2.2.2.
- Discuss the function of PEUFD.	- Refer to students manual item 2.2.3.
- Discuss the function of PSFD.	- Refer to students manual item 2.2.4.

Day-1, Lesson-2

(Suggested time for this section: Two hours).

Contents	Activities
3. Instrument line symbols. 4. Revision.	- Discuss with the students if they are familiar with process and instrument line symbols. - Has a revision for all what have been studied in day-1

Day-2, Lesson-1

(Suggested time for this section: Two hours).

Contents	Activities
1. Instrument identification or tag number. 2. Functional designation of relays.	- Have one or two of the students describe what is meant by instrument identification. - Explain the meaning of identification letters and give examples. - Refer to AFPC P&ID.

Day-2, Lesson-2

(Suggested time for this section: Two hours).

Contents	Activities
3. Special abbreviations. 4. General abbreviations.	- Discuss the special abbreviation through table-5 (student manual). - Discuss the general abbreviation through the tables in student manual.

Day-2, Lesson –3

(Suggested time for this section: Two hours).

Contents	Activities
5. ISA symbols.	- Discuss with the students information on ISA symbols. - **Show overhead T5/ T6/ T7/ T8/ T9/ T10/ T11.**
6.Typical arrangement of instrument connection.	- **Show overhead T12.** - Refer to typical AFPC P&ID.
7. Revision.	- Have a revision for all what have been studied in Day-1 and day-2.
8. Give Post- assessment (Final Test).	- This assessment covers all points of the course. - Have the students pass their answer to you and grade them. - Record grades and compare with the pre-assessment scores.

7. PRE AND POST (FINAL) ASSESSMENT AND MODEL ANSWERS

Pre- Course Assessment
Reading Drawings
PFD'S and P &ID's

Name : ---------- Location: ----------
Co. No.: ---------- Score : ----------

Answer the following questions:

Q.1 What is meant by the following identifications:

PFD: ----------

P&ID: ----------

PEUFD: ----------

PSFD: ----------

Q.2 Identify the information you can get from the following documentation:

PFD: ----------

P&ID: ----------

PEUFD: ----------

PSFD: ----------

Q.3 Explain the function of the following schemes.

PFD: ----------

P&ID: ----------

Q.4 Identify the line designations (symbols) of the following:

a. Main process line ----------

b. Traced main process line ----------

c. Insulated line ----------

d. Pneumatic signal ----------

e. Electrical signal ----------

Q.5 What is meant by the following instrument identifications (Tag Number):

1. FSH: ----------
2. TRC: ----------
3. RO: ----------
4. PIC: ----------
5. PDIC: ----------
6. LS: ----------
7. TT: ----------
8. LG: ----------
9. FR: ----------
10. FI: ----------
11. TE: ----------
12. TV: ----------
13. SDV: ----------
14. TCV: ----------
15. PSV: ----------
16. LAH: ----------
17. PSD: ----------
18. PAHH: ----------
19. FO: ----------
20. ESD: ----------
21. FC: ----------
22. AS: ----------
23. ES: ----------
24. S.P: ----------
25. FY: ----------

Q.6 Identify the function of the following designation of relays:

I/ P: ----------

A/ D: ----------

Q.7 Identify the meanings of the following instrument symbols:

 : ----------

 : ----------

 : ----------

 : ----------

 : ----------

 : ----------

Q.8 Draw the symbols of the following process valves:

- Globe Valve normally open ----------.
- Globe valve normally closed ----------.
- Gate Valve normally open ----------.
- Gate Valve normally closed ----------.
- Ball Valve normally closed ----------.
- Check Valve ----------.
- Butterfly Valve ----------.
- Needle Valve normally open ----------.

Post- Course Assessment
Reading Drawings
PFD'S and P &ID's

Name : ---------- Location: ----------
Co. No.: ---------- Score : ----------

Answer the following questions:

Q.1 What is meant by the following identifications:

PFD: ----------

P&ID: ----------

PEUFD: ----------

PSFD: ----------

Q.2 Identify the information you can get from the following documentation:

PFD: ----------

P&ID: ----------

PEUFD: ----------

PSFD: ----------

Q.3 Explain the function of the following schemes.

PFD: ----------

P&ID: ----------

Q.4 Identify the line designations (symbols) of the following:

a. Main process line ----------

b. Traced main process line ----------

c. Insulated line ----------

d. Pneumatic signal ----------

e. Electrical signal ----------

Q.5 What is meant by the following instrument identifications (Tag Number):

1. FSH: ----------
2. TRC: ----------
3. RO: ----------
4. PIC: ----------
5. PDIC: ----------
6. LS: ----------
7. TT: ----------
8. LG: ----------
9. FR: ----------
10. FI: ----------
11. TE: ----------
12. TV: ----------
13. SDV: ----------
14. TCV: ----------
15. PSV: ----------
16. LAH: ----------
17. PSD: ----------
18. PAHH: ----------
19. FO: ----------
20. ESD: ----------
21. FC: ----------
22. AS: ----------
23. ES: ----------
24. S.P: ----------
25. FY: ----------

Q.6 Identify the function of the following designation of relays:

I/ P: ----------

A/ D: ----------

Q.7 Identify the meanings of the following instrument symbols:

 : ----------

 : ----------

 : ----------

 : ----------

 : ----------

 : ----------

Q.8 Draw the symbols of the following process valves:

- Globe Valve normally open ----------.
- Globe valve normally closed ----------.
- Gate Valve normally open ----------.
- Gate Valve normally closed ----------.
- Ball Valve normally closed ----------.
- Check Valve ----------.
- Butterfly Valve ----------.
- Needle Valve normally open ----------.

Model Answer For pre and Post (Final)Course Assessment

Name : ---------- Location: ----------
Co. No.: ---------- Score : ----------

A-1 PFD: Process Flow Diagram.
P & ID: Piping and Instrumentation Diagram.
PEUFD: Process Engineering Utility Flow Diagram.
PSFD; Process Safeguarding Flow Diagram.

A-2 The PFD is a document containing the following information:

- Process conditions and physical data of the main process streams.
- Main process equipment with design data.
- Main Process lines.
- Main controls.
- Mass (material) balance.
- Heat balance (if applicable).

* The P&ID is a document containing the detailed design/ engineering data on:

- Stationary equipment.
- Fittings.
- Piping details.
- Lube oil and sealing systems.
- Instrument symbols and tag numbers.
- Control device symbols.
- Signal transmission lines.
- Alarms and tips.
- Shutdown devices.

* The PEUFD is a document containing information on main distribution and/or collection arrangement of each individual utility system, except electrical systems. Detailed design/ engineering data are given as on the P&ID mentioned above. In addition the PEUFD shows the mass and heat balances of the system concerned.

* The PSFD is a document high lighting information on types and levels of protection offered by the devices installed and their interrelation to demonstrate the plant's safety.

A.3 PFD:

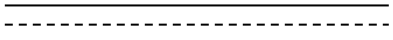
- Advanced ordering of special/long delivery equipment/materials base
- on the Preliminary Project Planning
- Obtaining a preliminary equipment summary list
- Composing preliminary plant layout
- Preparing preliminary cost estimate (25-40% accuracy)
- Preparation of the MID with data sheets.
- Preliminary risk analysis.

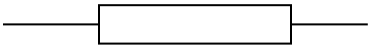
P & ID;

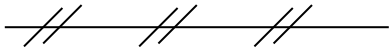
- Planning schedule
- Final plant layout development together with hazardous areas classification
- Preparing piping, instrument, safety relief valve and level gauge data sheets
- Construction contract specifications
- Developing piping layout drawings
- Bulk material ordering (piping, electrical, instrumentation, civil)
- Remaining equipment ordering
- Final capital cost estimate (engineering, purchasing and construction) 10% accuracy
- HAZOP studies/safety reviews
- Operations review
- Stating special requirements for start-up and shut-down

A. 4:

a. Main Line

b. Traced Auxiliary Line 

c. Installed Line 

d. Pneumatic Signal 

e. Electrical Signal

A. 5

1. PSH: Flow Switch High.
2. TRC: Temperature Recorder Controller.
3. RO: Restriction Orifice.
4. PIC: Pressure Indicator Controller.
5. PDIC: Pressure Difference Indicator Controller.
6. LS: Level Switch.
7. TT: Temperature Transmitter.
8. LG: Level Glass.
9. FR: Flow Recorder.
10. FI: Flow Indicator.
11. TE: Temperature Element.
12. TV: Temperature Valve.
13. SDV: Shut Down Valve.
14. TCV: Temperature Control Valve.
15. PSV: Pressure Safety Valve.
16. LAH: Level Alarm High.
17. PSD: Process Shut Down.
18. PAHH: Pressure Alarm High High.
19. FO: Fail Open.
20. ESD: Emergency Shut Down .
21. FC: Fail Close.
22. AS: Air Supply.
23. S. P: Set Point.
24. FY: Flow Relay.

A-6. I/ P Change electric signal to pneumatic signal
A/ D Change analog signal to digital signal.

A-7.

 :Locally mounted instrument.

 : Instrument Mounted on Local Board.

 : Instrument Mounted on Main Board.

 : Instrument Mounted on Rear Local Board.

 : Instrument Mounted on Rear Main Board.

 : Shared Display in Control Roam.

A. 8

1		Globe valve normally open
2		Globe valve normally closed.
3		Gate valve normally open.
4		Gate Valve normally closed.
5		Ball valve normally closed.
6		Check valve.
7		Butterfly Valve.
8		Needle valve normally open.

8. Appendix