

 COMPANY : TOTAL SOUTH PARS	TECHNIP ENGINEER	Doc N° : DB 5561V 999 P312 203 Rev. 1	Page : 1/26
SOUTH PARS FIELD DEVELOPMENT PHASES 2 & 3 ONSHORE FACILITIES ASSALUYEH - IRAN		Company Project N° : TSP 2/3 SP/PJ/005 Engineer Project N° : 5561 V	

DESIGN BASIS FOR PID DEVELOPMENT



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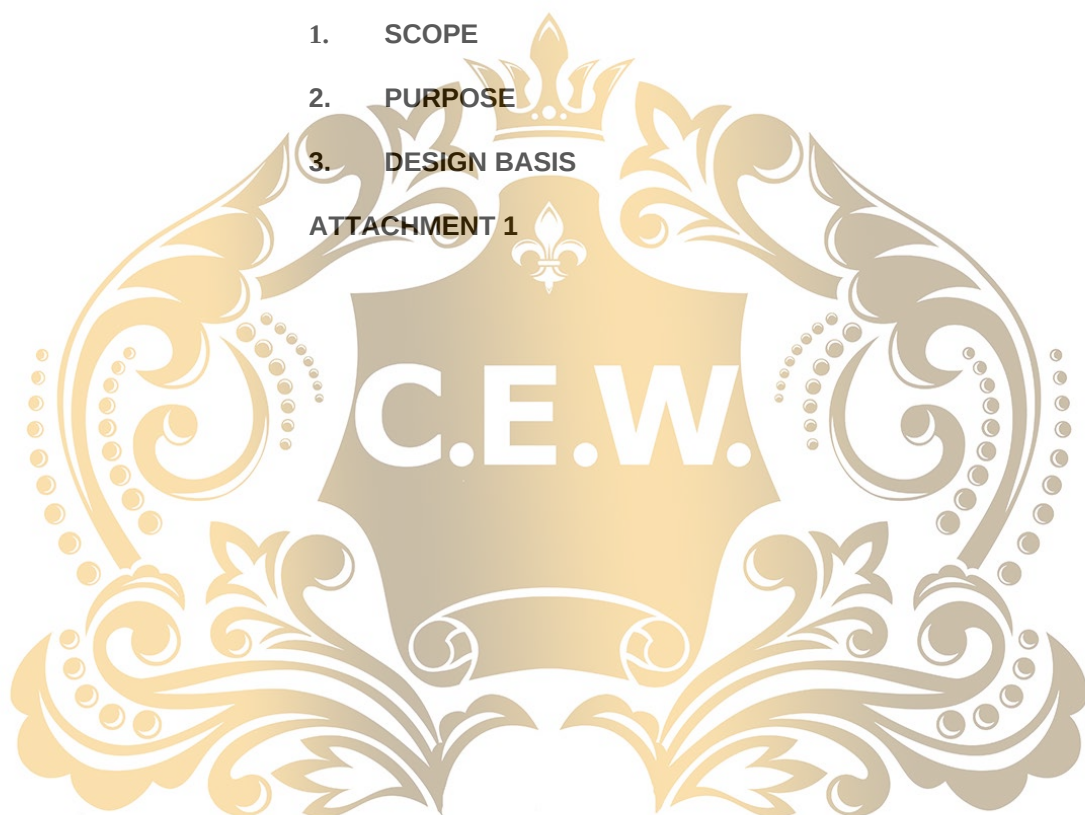
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1	Aug.19 th 98	J.L. ROMANI	JL ROMANI	R. AGAZZI	I.F.D
0	June 11 th 98	J.L. ROMANI	JL ROMANI	R. AGAZZI	I.F.A
A	Mar.13,1998	J.L. ROMANI	R. AGAZZI	Ph. COLLET	I.D.C.
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1. SCOPE

This procedure outlines the design basis to be applied for PID elaboration of ONSHORE FACILITIES of SOUTH PARS FIELD DEVELOPMENT (Phases 2 &3) Project which are located at ASSALUYEH, IRAN. In the event of a conflict between this basic document and *Licenser PFD's and guidelines for PID's*, the *Licenser documents* shall prevail. Any modification of these documents, and included in PID's at detailed engineering stage, shall be approved by Licenser.

2. PURPOSE

The purpose of this document is :

- ◆ at the FEED stage, to gather PID details so that they can be integrated to the process unit in a coherent and uniform way.
- ◆ at the Detailed Engineering stage to :
 - explain and clarify the options selected for PID's elaboration at the FEED stage
 - define the minimum requirements for completion by EPC contractor of identified items missing on FEED PID's.

The list of PID details treated by this document is not exhaustive , which means that it will be completed in order to comply with any new problem which *would* arise and which *would* be judged to be common to Company and Engineer work.

3. DESIGN BASIS

◆ At FEED stage

The design basis used for PID development at the FEED stage are detailed in attachment 1 of the present Project Procedure.

These process considerations shall be used to complete, if needed, the PID developed by Licenser. The PID details mentioned in the attachment 1 must be used as guideline only.

Any change made to the PID given by the Licenser shall be addressed to the Licenser via Company.

◆ At detailed engineering stage

The attachment 1 shall be considered by the EPC contractor for a better understanding of the selected standards used on the PID's and for completion of PID's.

The following items (non exhaustive list) listed hereafter shall be developed or followed by EPC contractor :

1. Assembly recommendations for filters at pump suction shown on table "A" PID 5561 V 999 0030 0006 have to be followed. The filters arrangement drawn on PID shall not be considered as an installation requirement.
2. Stand pipe has to be shown on PID's.
3. Material selection for piping and equipment shall be in accordance with depressurisation studies results.
4. Upstream/downstream PSV line diameter has to be shown on PID's..
5. Upstream/downstream BDV line diameter has to be shown on PID's.

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6. *PSV size and number, control valve manifold sizing has to be shown on PID's*
7. *EPC contractor shall review requirements for thermal expansion relief valves installation based on piping routing and installation rules defined in DB 5561 V 999 P312 209.*
8. *EPC contractor shall pay attention to BDV installation requirements for isolated part of pipe regarding the BDV installation rules explained in DB 5561 V 999 P312 209.*
9. *EPC contractor to review compressor system according to pulsation / vibration studies.*
10. *EPC contractor to define air cooler by-pass line according to thermal rating performed by vendors, based on the process requirement.*
11. *At the FEED stage PSV have been located on equipment. However, Company criteria is to minimise the nozzles number on vessels and therefore PSV relocation on overhead vapour lines should be considered by EPC contractor if no demister is installed, within API constraints for upstream pressure loss (or any other constraint).*
12. *Double block and bleed assembly (solid block assembly) shall be considered by EPC contractor on high pressure service.*
13. *Pressurisation by-pass (location and sizing) shall be reviewed by EPC contractor and specified as required for plant start up.*
14. *Control valves isolation for maintenance to be reviewed (need of upstream/downstream block valves).*
15. *Flow measurement types to be reviewed regarding considerations of pressure drop, rangeability,...*

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ATTACHMENT 1
Used for PID's development at FEED stage

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1. GENERAL CONSIDERATIONS

1.1 PID definition

PID (PIPING AND INSTRUMENT DIAGRAM) : detailed drawing used for construction and operation of the processing plant including associated off sites and utility fluids.

PID's symbol are required for a good understanding and also permit to give some symbolic representations on PID's.

It contains :

- all equipment with their reference,
- all lines (main and temporary) with their numbering (including nominal diameter, fluid service identification, piping material class, insulation and line number),
- piping class change,
- particular line fittings (strainers, flame *arrestor*, reducer, cap, flanges, spacer, spectacle blind,...(flame *arrestors* should not be considered as line fittings but as itemised pieces of equipment)
- all piping valves with their types, all actuated valves shall be itemized and their fail safe position indicated, manual valves locked position to be indicated, car seal position, if applicable, should be shown on PID's.
- all RSV's, rupture disks and restriction orifices with their items,
- complete instrument representation with the control loops details, numbering and location,
- insulation, tracing, slope,
- equipment elevation,
- notes for explanation and good understanding

etc. ..

In all cases the location of main equipment symbols sheet has to take into account the location of each equipment on the plot plan *and on the fluid path*.

Due to the importance of the details, it is possible to have only one main equipment represented on one sheet.

For each equipment, a reference (item number) is given close to the symbolic representation.

A table also gives the item number for each equipment, the function or service and the main *characteristics* values.

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2. EQUIPMENT

2.1 Heat exchangers

Notes :

1. The ¾" outlet purge located on cooling water/sea water side will serve as a sample connection.
2. If heat exchangers are installed at 15 m or more above ground, the addition of one vacuum breaker (or booster pump) on the cooling water side has to be examined case by case.
3. Cleaning (for HC side) :
 - A 2" nozzle with valve and blind flange for cleaning, on fouled side, shall be installed on the line . When exchangers are in line, only one nozzle will be installed (one at inlet and outlet of the group of exchangers) .
 - For cleaning purpose, exchanger will be isolated and bypassed. Exchangers to be cleaned will be defined case by case .
4. As a general rule, temperature control will be installed on primary circuit (i.e. not on cooling water for example) .

2.2 Air cooler

Notes :

1. Vent

All air cooler condenser shall be equipped with 2" vent at high point used only for maintenance (infrequent).
2. Cleaning nozzle

A 2" cleaning nozzle if needed with valve and blind flange shall be installed on air cooler and not on process line .
3. Air condenser

A self draining line shall be provided between the air condenser outlet and the reflux drum .

For air condenser, the equipment shall be self draining (slope 1%)
4. Air condenser header

Header ends to be plug type. *However, cover plate header type can be specified on high fouling (higher than 0.0004 m².°C/W) low pressure service (rating 150#).*
5. Air cooler type

Air cooler to be induced type when air cooler is installed on pipe rack. Forced draft type shall be considered

 - if air cooler is installed at grade
 - if inlet process temperature is above 175°C or air outlet over 93°C
 - or for multiple purpose exchangers, several sections stacked
6. Air cooler bay isolation

Isolation of air cooler bay is not required. However, air cooler shall be considered as flow limiter and therefore PSV are required on both column overhead and reflux drum.

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2.3 Pumps

For arrangement of installation, refer to PID symbol .

1. Suction filter

Y filters will be used for pipe size up to 2", T filter for 3" and above .

2. Vent

The following considerations shall be considered as a complement on PID symbol .

Pump casing vent shall be provided if casing and flange arrangement of pump does not allow natural self venting. *This vent may be routed to atmosphere for non toxic product.*

A vent will be installed on pump casing and vented to a closed drain system. *This vent may be routed to atmosphere for non toxic product.* Alternate to this arrangement can be considered : self priming pump .

A vent , connected to suction drum , shall be installed for pump on cold product (for which vaporisation temperature , at suction pressure , is less than ambient temperature).

3. Maintain in temperature

A ¾" by pass on check valve (at discharge line) or 2" bypass depending on process line diameter shall be provided for all services.

This by-pass will be opened for cold service, high temperature service (temp> 230 °C) or high pour point service. For other service, this by-pass will be maintained to drain, if necessary, the piping part between check valve and block valve. *Alternatively, during EPC phase, a 5 mm (or suitable) weep hole through check valve may be considered for maintain in temperature not for drain (in that case a specific drain connections shall be required).*

4. Block valve : type and size

If ball valves are installed at pump suction, full bore type valves shall be *installed*.

Diameters for valves at suction and discharge lines regarding pumps nozzles diameters are as follows :

- Suction line : in all cases, valve has the same diameter as the line.
- Discharge line : if line size is one diameter greater than nozzle, check valve and block valve will have the same size than the pump nozzle.

If line size is more than one diameter greater than pump nozzle, check and block valve will be in the immediately lower discharge line diameter (e.g. nozzle 4", pipe 10", check + block valves 8")

5. Automatic start

- As base case, pump automatic start will be done generally through FSLL (if flow transmitter already exists).
- Automatic start is determined considering the following rules :
 - personnel safety : for example flare KO drum pump will be started in order to avoid liquid in flare tips. In that case, considering the non continuous operation of flare drum pumps, the start of the spared pump can be performed by LSH or by DCS logic.
 - equipment safety : for example BFW pump will be started in order to protect the steam drum and the steam coil.
 - severe process upset : pump generating by its shutdown one process unit trip or generating an off spec product shall be spared automatically.

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- flaring: automatic start shall NOT be considered to minimise the flaring. For example, reflux pumps, *unless a severe process upset is faced*.
- *For detail on instrument control and safeguarding philosophy , refer to RP 5561 V 999 1511 21.*

2.4 Vessels

1. Liquid side draw-off

For side draw off lines , a vertical part of line (~3 m) shall be provided just after column nozzle in order to avoid liquid vaporisation. Valve, if any, on this line shall be located in horizontal position and mounted flange to flange with the column nozzle .

2. Drain and utility connections (steam out, purging) :

Refer to DB 5561 V 999 P312 205 *Process sizing criteria*.



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3. INSTRUMENTS

3.1 Control valves

Refer to typical arrangement drawing, on PID symbol.

Notes:

1. Control valve manifold

- *For control valve size less than or equal to 6"*

Control valves are equipped with block valves and by-pass, except *control valve in non continuous service*. Sizes of block valves and by pass are in accordance with API RP 550 (see tabulation hereunder).

Exception is made for flash service : the downstream block valve and piping - located between control valve and block valve - shall have the same diameter as downstream line .

- *For control valve size greater than 6"*

A control valve will be provided with hand wheel and no by pass with block valve unless specified case by case. For main utility control valves (fuel gas and air), by pass normally comprises a spare on line control valve.

For isolation of control valves for maintenance purpose, design shall consider the addition of block valve upstream/downstream control valve or the use of the closest valve to minimize spill or loss of product.

2. When control valves are used as SDV and linked to the ESD system, by pass line will be equipped with a block valve specified as car sealed closed (C.S.C.)

3. ¾" bleed of control valve manifolds

- *For process line (upstream CV) greater than or equal to 6"*

IF Control valve is FO, ¾" bleed with block valve and blind flange will be installed downstream control valve.

IF Control valve is FC, two ¾" bleed with block valve and blind flange will be installed downstream and upstream control valve.

- *For process line (upstream CV) less than or equal to 4"*

¾" bleed with block valve and blind flange will be installed downstream control valve whatever the control valve position (FO or FC) by fluid failure.

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TABLE OF BLOCK VALVES AND BY-PASS SIZES UP TO Ø = 16"

BLOCK AND BY PASS VALVES DIAMETER REGARDING LINE DIAMETER		CONTROL VALVE SIZE													
		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	
Line dia.															
1/2"	BLOCK BY-PASS	1/2" 1/2"													
3/4"	BLOCK BY-PASS	3/4" 3/4"	3/4" 3/4"												
1"	BLOCK BY-PASS	1" 1"	1" 1"	1" 1"											
1 1/2"	BLOCK BY-PASS	1 1/2" 1 1/2"	1 1/2" 1 1/2"	1 1/2" 1 1/2"											
2"	BLOCK BY-PASS		2" 2"	2" 2"	2" 2"	2" 2"									
3"	BLOCK BY-PASS			2" 2"	2" 2"	3" 2"	3" 3"								
4"	BLOCK BY-PASS				3" 3"	3" 3"	4" 3"	4" 4"							
6"	BLOCK BY-PASS					4" 4"	4" 4"	6" 4"	6" 6"						
8"	BLOCK BY-PASS					6" 6"	6" 6"	8" 6"	8" 8"						
10"	BLOCK BY-PASS						8" 8"	8" 8"	10" 8"	10" 10"	10"				
12"	BLOCK BY-PASS							10" 10"	10" 10"	12" 10"	12" 12"				
14"	BLOCK BY-PASS									12" 10"	14" 12"	14" 14"			
16"	BLOCK BY-PASS										14" 12"	16" 14"	16" 16"		

API.RP.550

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3.2 Relief valves

Refer to typical arrangement drawing on PID symbol.

1. Criteria for installation of PSV's and TSV's

Refer to DB 5561 V 999 P312 209

Spool piece will be installed upstream PSV. However, advantage of the presence of spacer at capacity outlet can be considered.

PSV bypass line diameter to be 2" whatever the vessel capacity is.

2. Spare relief valve : a spare relief valve is always installed except :

- if the protected equipment can be isolated and de *pressurized* / drained without production shutdown.
- if the installed relief valve is only used for fire case, in that case the spare relief valve is stored in warehouse (note on PID to be added).

For both cases, isolation with bleed is required (refer to typical drawing).

3. PSV set pressure

If two or more PSV are in service, the set pressure will be staggered to avoid chattering. The difference between set points shall be less than 5 % of the design pressure. Staggering of PSV will be indicated on PID when applicable with respect to API considerations.

4. PSV number. (*Rules to be applied for PID's development at FEED stage*)

- One PSV shown on PID (with one spare provided and located in warehouse) means that PSV will be designed for fire case only.
- Two or more PSV's (n + 1spare) shown on PID means that safety valves are designed for other case than fire. If 3 PSV's are shown, this means that multiple PSV's in operation are expected.

5. PSV installation (*Rules to be applied for PID's development at FEED stage*)

PSV will be installed directly on vessel.

6. Thermal expansion

- For all exchangers which can be isolated , the cold side will be equipped with a thermal expansion valve ¾ " x 1" .
- A single TSV shall be provided for pipework thermal relief.
- TSV's are discarded where a PSV is already installed.
- TSV's are not spared, valve with bleed to be installed upstream TSV.

7. Rotative and dosing pump

- Rotative and dosing pump shall be protected by an external relief valve between discharge and suction lines.
- The internal protection - generally included in vendor's scope - can be considered as a safety device when the following parameters are reached :
 - pump capacity < 225 l /h
 - non corrosive and non toxic product
 - relief valve setting < 17.5 barg

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3.3 Flow meter

a. Rotameter

Rotameter will be installed vertically .

b. Flowmeter indication

Vapour phase to be compensated by T and P if temperature and pressure measurements exist *and if required due to temperature / pressure process fluctuations.*

c. Flowmeter type

Except otherwise required for process reasons, flow measurement, including compressor suction lines will be performed by orifice plates. *Proper selection to be carried out by EPC contractor regarding low pressure drop requirement, applicability.*

3.4 Temperature element

Notes :

- When two streams are mixed , the temperature element will be installed on common line at least at 10 x dia from the mixing point .
- As general rule, temperature element on column will be installed as follows :
 - tray liquid temperature element will be installed in downcomer at 100 mm from the bottom
 - tray vapour temperature element will be installed at 200 mm above the tray, the element coming inside the column by 300 mm .
- Column top temperature element shall be installed on pipe as close as possible from column nozzle.
- Except for specific locations (columns for instance), all TW's will be fitted with *local TG's which* are installed for performance monitoring (on demand) and not used permanently for daily unit control or *adjacent TI* check.
- TG's required for exchangers performance check are *installed. All nozzle above 2" diameter shall be equipped with TW on TEMA type exchangers and air coolers . TI (DCS) shall be kept for critical parameters essential for the operator.*
- Lines smaller than 4" will be locally enlarged to 4" if a TW or TG installation is required.

3.5 Pressure element

Notes :

- Pressure element will be installed preferably on vapour line and not on capacity.
- Pressure element will be installed , at pump discharge line , upstream check valve .
- For split range controller, duplicated PIC at PCS level made from single pressure transmitter will be considered to allow different set points on each.

3.6 Level element

Notes :

- Stand pipe *may* be installed on clean service (i.e. to be applied on utility service, process fluids in units 104/105/107 and 106) when at least 3 level instruments have to installed *Refer to Process sizing criteria DB 5561 V 999 P312 205.*
- Minimum size for stand pipe : 3"
- Level element used for safety action shall not be installed on stand pipe provided for level indication and control.*

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4. PIPING

4.1 Sloping requirements

1. Sloping requirements shall be indicated on PID's.
2. Flare header and sub-header
 - Block valves shall be avoided. However, full bore ball valve with position indicator are required for maintenance at each unit battery limit :
 - Flare header shall self drain towards flare drum.
 - All connections shall be made with no low point and preferably on the top of the header. Connection to the header should be made with a 45° angle except for smaller diameter up to 4".
 - Flow orifice or flow meter (except annubar type or equivalent) which can be blocked by foreign matters shall not be installed.
3. Low point at compressor suction is allowed provided that low point shall be equipped with drain. Compressors anti-surge lines should preferably slope to suction and discharge drums with anti-surge valve at high point.

4.2 Utility connection

Refer to typical arrangement.

4.3 Valve type

The following guide line will be applied :

- BLOCK VALVE

FLUID	150 #	300 #	600 #	900 #
Stabilised liquid	$\Phi \leq 8"$ ----> GATE	$\Phi \leq 8"$ ----> GATE	BALL	BALL
	$\Phi \geq 10"$ ----> BALL	$\Phi \geq 10"$ ----> BALL		
Sour HC, non stabilised HC LPG	BALL	BALL	BALL	BALL
Lean amine	$\Phi \leq 8"$ ----> GATE	$\Phi \leq 8"$ ----> GATE	BALL	BALL
	$\Phi \geq 10"$ ----> BALL	$\Phi \geq 10"$ ----> BALL		
Rich amine	BALL	BALL	BALL	BALL
Sour gas or toxic product (mercaptans)	BALL	BALL	BALL	BALL
Sweet gas	$\Phi \leq 8"$ ----> GATE	BALL	BALL	BALL
	$\Phi \geq 10"$ ----> BALL			
Steam	GATE	GATE	GATE	GATE

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Notes :

1. Ball valve to be used for service where design temperature $\leq 200^{\circ}\text{C}$
2. Ball valve to be used for isolation purposes:
 - at battery limit
 - at all spared equipment opened during operation (filters, pumps...)
3. Valve to be motorised from $\Phi \geq 24"$.
4. Butterfly to be used on cooling water service mainly for pipe diameter $\geq 2"$.
5. For PSVs :
 - gate valve to be provided upstream PSV for rating up to 150 # and for diameter lower than or equal to 8" and for non sour service *or non toxic*.
 - valve located downstream PSV to be gate valve type for non sour service and ball valve type for sour service *or toxic*.

4.4 Double valving and bleed

- Double valving is required on all fluids meeting one of the following conditions :
 - operating pressure above or equal to 70 barg
 - H_2S partial pressure > 1 bara
 - very corrosive/abrasive fluid
- Therefore, double valving will be located from slug catcher area down to HP separator inlet, at export gas compressor discharge and at unit 103 inlet.
- Type of valve used : refer to § 4.3. Bleed valve is $\frac{3}{4}"$.
- Where double valving and bleed is required, solid block assembly replacing piping valves on chemical injection and instrument tapings shall be considered. For detail refer to PID symbol.

4.5 Closing / opening of valve

The specification Car Seal Close or Car Seal Open shall be preferred to Lock Close or Lock Open except for valve on flare header .

4.6 Pressurisation valve by pass

4.6.1 Pressurisation by manual valve by pass

a. Implementation of by-pass

By pass manual valve will be added to pressurise downstream system on the following services :

- steam line or equipment heating
- pressurisation or depressurisation of equipment / section
- balance line

Steam network

A by pass on block valve will be considered at steam turbine inlet. For other services, bypass valve will be installed on a case by case basis.

Process gas

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A by pass will be added on block valve isolating a group of equipment, special equipment or part of unit for 600 # and above and diameters greater than or equal to 4". For 300#, pressurisation bypass valve will be added on a case by case basis.

Liquid network

A by pass will be added on a part of unit when the following conditions are reached :

diameter $\geq 6"$ and temperature $\leq -15^{\circ}\text{C}$

diameter $\geq 6"$ and pressure ≥ 50 barg

b. Type and size of by pass valve

A globe valve type will be selected .

The by pass size is determined as follows :

Line diameter	By pass diameter
up to 8 "	1"
10" up to 14"	1"1/2 (*)
$\geq 16"$	2" (*)

(*) Unless greater size dictated by process constraint such as pressurization time

4.6.2 On/off valve bypass (SDV)

When on/off valves are equipped with pressurisation bypass, advantage shall be taken not to oversize the *valve actuator*.

4.7 Isolation

4.7.1 Isolation philosophy

General basis :

The general rules for the process block isolation are the following ones :

- ◆ All equipment will be generally isolated by spacer (depending on nozzle size), installed at minimum distance of equipment and will be easily accessible.
- ◆ Double block and bleed is required for parts located from slug catcher area down to HP separator inlet, at export gas compressor discharge and at unit 103 inlet.
- ◆ For other services, single block valve with spacer (considered as a positive protection) is provided depending on nozzle diameter.
- ◆ *Maintenance* will be performed per phase *when the equipment is common to one phase (i.e. stabilization unit) or per train.*
- ◆ ESDV's and SDV's can be used for block isolation. In that case, for maintenance purpose, SD2 / 3 or ESD1 can be activated provided that main equipment are already shutdown locally by operators or using remote control.
- ◆ Isolation of a single equipment does not mean that it is fitted with specific dedicated block valves ; block valves of a contiguous equipment can be used. For instance the block valves of each bay of a column air condenser are used as inlet block valve for the reflux drum.

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4.7.2 Spacers

Spacers to be installed using the following rule :

RATING ANSI	SPACER TO BE INSTALLED FOR
150 #	$\Phi \geq 6"$
300 #	$\Phi \geq 4"$
600 #	$\Phi \geq 2"$
900 #	$\Phi \geq 2"$

When spacers are not installed, no alternative to spacers shall be considered as lines are assumed to be flexible enough.

4.8 Sample connection / analyser connection

Cooling to be provided on sample connection when operating temperature exceeds 70 °C, or for process reason. Refer to P.I.D. with details and types of sample connection PID N° 5561 V 999 0030 0009.

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4.9 Drain network

PROCESS UNIT	FLUID	DRAIN SYMBOL	UNDERGROUND NETWORK
100 PHASE 2	HC	DR	100-D-103 100-P-101
100 PHASE 3	HC	DR	100-D-203 100-P-201
103 TRAIN 1	HC	DR	103-D-108 103-P-104
103 TRAIN 2	HC	DR	103-D-208 103-P-204
GAS TRAIN 1 + TRAIN 2 (101+104+105+107+ 114)	HC + COLD HC	DR DP	105-D-106 105-P-106
	AMINE	DA	101-D-106 101-P-107
	TEG	TD	104-D-103 104-P-102
GAS TRAIN 3 + TRAIN 4 (101+104+105+107+ 114)	HC + COLD HC	DR DP	105-D-306 105-P-306
	AMINE	DA	101-D-306 101-P-307
	TEG	TD	104-D-303 104-P-302
102	MEG	GD	102-D-105 102-P-104
106	LIGHT HC	DP	(1)
114	CAUSTIC	DC	114-D-104 114-P-104
109	HC+WATER	DS	109-D-104 109-P-105
141	HC	DR	141-D-101 141-P-101
146	Chemicals	DA/MD/TD/MT/ SD	146-D-103

(1) Piping pot

4.10 Steam tracing and insulation

Refer to SPP 5561 V 999 INF 001 .

4.11 Unit battery limit

4.11.1 Location

Battery limit valves will be located at grade only in cases of interconnection with a pipe way. When interconnecting a pipe rack to a pipe rack, battery limit valves are installed on the pipe rack and provided with platform for accessibility.

Valve arrangement (horizontal or vertical) depends on site conditions. General arrangement is on a horizontal line ; vertical arrangement only if previous arrangement not possible.

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4.11.2 Valving arrangement

a. Drain size

for line diameter $\leq 4"$

purge diameter (V or P) = $\frac{3}{4}"$

for line diameter $> 4"$

purge diameter (V or P) = $2"$

b. typical arrangement for process fluid

	Double block valve	Bleed (if required by double valving)	Type of valve (1)	Drain	Valve bypass	Spacer
SOUR GAS	refer to §4.4	connected to FA	BALL	Yes	refer to §4.6	Yes
SWEET GAS	refer to §4.4	Not connected	BALL	Yes	refer to §4.6	Yes
SOUR LIQUID HC	refer to §4.4	connected to DR	BALL	Yes	refer to §4.6	Yes
LIGHT HC/LPG	refer to §4.4	connected to DP	BALL	Yes	refer to §4.6	Yes
SWEET HC	refer to §4.4	Not connected	BALL	Yes	refer to §4.6	Yes
MEG	refer to §4.4	connected to GD	BALL	Yes	refer to §4.6	Yes
TEG	refer to §4.4	connected to TD	BALL	Yes	refer to §4.6	Yes
AMINE	refer to §4.4	connected to DA	BALL	Yes	refer to §4.6	Yes

(1) For temperature higher than 200°C, gate valve type to be used.

c. typical arrangement for utility fluid

	Double block valve + bleed	Type of valve	Drain or vent	Valve bypass	Spacer
Steam condensate	No	GATE	Yes	refer to §4.6	Yes
HP steam	No	GATE	Yes	refer to §4.6	Yes
LP steam	No	GATE	Yes	refer to §4.6	Yes
Fuel gas	No	BALL	Yes	refer to §4.6	Yes
Nitrogen	No	GATE	Yes	refer to §4.6	Yes
Inst/plant air	No	GATE	Yes	refer to §4.6	Yes
BFW	No	GATE	Yes	refer to §4.6	Yes
Utility water	No	GATE	Yes	refer to §4.6	Yes
Cooling water	No	BUTTERFLY	Yes	refer to §4.6	Yes
Potable water	No	GATE	Yes	refer to §4.6	Yes
Demin. water	No	GATE	Yes	refer to §4.6	Yes

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5. SAFEGUARDING

Definition : all operating procedures , instruments , devices , monitoring and control systems are dedicated to plant process control and process safety in order to maintain the plant operation at marginal risk .

The purpose of this paragraph is to *summarize* the main considerations about safeguarding. For details, refer to C&E charts and control and safeguarding documents. In case of discrepancies between this paragraph and instrument control and safeguarding philosophy, RP 5561 V 999-1511-21 shall prevail.

5.1 Definition of shutdown / control level

5.1.1 Architecture of the ESD system

Refer to Relief and blowdown philosophy DB 5561 V 999 P312 209.

5.1.2 Shut-down levels

Level 0 : not applicable for on shore facilities

Level 1 : ESD 1 FIRE ZONE EMERGENCY SHUT DOWN

♦ cause :

- voluntary decision
- loss of control (UPS low voltage..)
- gas detection (ESD1G)
- fire detection (ESD1F)

♦ consequence :

- shutdown of fire zone (process + utility) by means of ESDV
- generates SD2/SD3 directly or using cascade effect depending on system reaction time
- on gas detection all ignition sources shall be shutdown
- on fire detection, fire protection systems (*fire fighting means shall be activated automatically*) are activated and all electrical motors are tripped ; however electricity is kept.
- depressurisation of fire zone : no automatic depressurisation is foreseen. ESD1 gives the permissive use of a push button to depressurize *the* fire zone. *Normally one fire zone after one will be depressurized, exception is common mode failure (number of fire zones that can be depressurized simultaneously is depending on flare load considering the instantaneous flowrate generated by the depressurisation).*

♦ remarks :

- on ESD1G, ignition sources suitable for use in zone 1 can be sustained.
- on ESD1F, electrical power remains in service ; however, all electrical users shall be shutdown

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Level 2 : SD 2 FUNCTIONAL UNIT SHUT DOWN

- ♦ cause (non exhaustive list) :
 - ESD1
 - voluntary decision
 - major process upset (including loss of utility)
- ♦ consequence :
 - shutdown of functional unit by means of SDV .
 -

Level 3 : SD 3 EQUIPMENT SHUT DOWN

- ♦ cause (non exhaustive list) :
 - SD2
 - voluntary decision
 - low low level closing downstream control valve to avoid gas blow by
 - low low level tripping the pump
 - high high level to shutdown the feed
 - high high level to shutdown compressor
 - high high pressure of column to shutdown steam through reboiler
 - compressor section shutdown by : PSHH, TSHH
 - pump suction to be isolated to avoid mechanical seal leakage
- ♦ consequence :
 - shutdown of equipment directly or by means of SDV (ESDV will be used only for fuel gas trip valve).
 - isolation of equipment
 - isolation of stand by equipment in operation

5.2 Reliability and devices

The redundancy for instrumentation is defined as follows :

PCS : implemented on DCS

- level and pressure transmitter shall be backed up by a local gauge:
LT+LG
- level and pressure transmitter used by control loop shall be backed up by a local gauge:
LIC+LG / PIC+PG
- temperature transmitter used by control loop shall be backed by a local TG : TIC+TG

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Level 3 : implemented on PCS or package PLC

- sensor : will be done by an independent transmitter .
- action :
 - *on control valve* equipped with solenoid is allowed in case of small inventory : less than 5 m3 of liquid hydrocarbon or PV< 100 bar.m3 for gas. In that case, control valve will be designed taking into account the following specifications :
 - TSO
 - FC
 - manifold control valve by pass : CSC
 - auto reset giving authorisation of remote opening
 - *on SDV*
 - *bypass authorized*
 - TSO
 - FC
 - *no fire proof requirement*
 - auto reset giving *authorization* of remote opening
 - no local reset except for process reasons
 - no air back-up except if double acting

Level 2 : implemented on ESD PLC

- sensor : will be done by one independent transmitters . When two or three similar measurements shall be provided , they shall have :
 - separate tapping for pressure
 - separate thermowell for temperature
 - common primary element (orifice plate) with separate impulse lines
- action :
 - *on control valve* equipped with solenoid is allowed in case of small inventory : less than 5 m3 of liquid hydrocarbon or PV< 100 bar.m3 for gas. In that case, control valve will be designed taking into account the following specifications :
 - TSO
 - FC
 - by pass CSC
 - remote reset
 - *on SDV*
 - *bypass authorized*
 - TSO

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- FC
- *no fire proof requirement*
- remote reset
- no local reset except for process reasons
- no air back-up except if double acting

Level 1 : implemented on ESD PLC

- sensor : ESD1 will be generated by operator through two ways
 - Push button hardwired
 - Push button through PLC system
- action :
 - *on control valve not permitted*
 - *on ESDV*
 - bypass NOT *authorized*
 - TSO
 - FC
 - fire proof
 - local reset
 - no air back-up except if double acting

5.3 Depressurisation (EDP)

5.3.1 Applicability

EDP shall be applicable to gas and condensate.

No automatic EDP is foreseen.

EDP is not applicable to pipeline and slug catcher. However for slug catcher, XV will be provided to vent the equipment. *Additional facilities will be installed for controlled sealine depressurisation using variable orifice for constant flow and minimization of time to depressurise.*

EDP is applicable to piping and equipment which can be isolated, exposed to fire and followed the rule :

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		BDV required
PIPING	that cannot be isolated	No
	that can be isolated but are not exposed to fire	No (1)
	that can be isolated and are exposed to fire (5): - flammable gas - liquefied HC (4) - liquid HC - two-phase - toxic gases	- $P > 7 \text{ bar g}$ and $PV_{\text{gas}} > 100 \text{ bar.m}^3$ - M_{gas} or $M_{\text{liq}} > 2 \text{ tons of C}_4$ and more volatile - No (3) (6) - $P > 7 \text{ bar g}$ and $PV_{\text{gas}} > 100 \text{ bar.m}^3$ - As required for protection of personnel
VESSELS	that cannot be isolated	No
	that can be isolated but are not exposed to fire	No (2)
	that can be isolated and are exposed to fire (5): - flammable gas - liquefied HC (4) - liquid HC - two-phase - toxic gases	- $P > 7 \text{ bar g}$ and $PV_{\text{gas}} > 100 \text{ bar.m}^3$ (6) - M_{gas} or $M_{\text{liq}} > 2 \text{ tons of C}_4$ or C_3 - No (3) (6) - $P > 7 \text{ bar g}$ and $PV_{\text{gas}} > 100 \text{ bar.m}^3$ (6) - As required for protection of personnel

Notes:

(1) Except piping interconnecting equipment subject to EDP within one process unit, regardless of pressure and volume.

(2) Except vessels between other vessels or piping within the same process unit and subject to EDP.

(3) TSV or PSV fire cases are regarded as sufficient protections.

(4) Both refrigerated or under pressure.

(5) Piping or vessels shall be considered as being possibly exposed to fire if more than 10 % of their external surface can be engulfed in a pool fire likely to last more than 3 minutes.

(6) The presence of pressurized fluid “trapped” in the network after EDP shall be avoided. The position of check valves and/or control valves failing to close shall be carefully contemplated in this respect.

(7) BDV protecting an equipment with mesh will be installed upstream the mesh

(8) Depressurisation to be avoided through plate and frame exchanger.

P : Maximum operating pressure (PSHH)

V : Internal vessels (or piping or vessel + piping) volume

V_{gas} : Gas phase volume

V_{liq}/V_{gas} (LAHH/LALL) : Maximum liquid/gas volume inside vessel or piping or both

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Mliq/Mgas Maximum : Mass of liquefied hydrocarbon liquid phase/gaseous phase inside vessel (or piping or both)

EDP can be also performed if required by package vendor (compressor).

5.3.2

Devices

Two type of depressurisation can be considered :

Level 1 : implemented on ESD PLC

- device : EDP is generated by operator through two push buttons (one using ESD PLC, the other to be hardwired).

Level 3 : implemented on DCS or PLC package

- device : EDP is generated by PLC package : e.g. depressurisation of compressor section will be performed through PLC package.

These two shutdown levels will depressurize vessels by means of BDV:

- **BDV**
 - TSO, Full Bore
 - FO, de-energized to open (except for slug catcher : *XV energized to open*)
 - equipped with bottle with two solenoid if ESD1 and SD3 act on same BDV
 - *no fire proof requirement*
 - local reset
 - the greater value between 3 strokes mini or 30 min. of bottle capacity
 - mini diameter higher or equal to 2".

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6. EQUIPMENT CONTROL

For equipment control, refer to instrument control and safeguarding philosophy
 RP 5561 V 999 1511 21.

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