ENGINEERING STANDARD

FOR

PROCESS DESIGN OF EMERGENCY MEASURES

ORIGINAL EDITION

MAR. 1996

This standard specification is reviewed and updated by the relevant technical committee on June. 2002. The approved modifications are included in the present issue of IPS.

CONTENTS : PAGE No.

0. INTRODUCTION

"Process Design of Safeguarding Systems for OGP Processes" are broad and contain various subjects of paramount importance. Therefore, a group of process engineering standards are prepared to cover the subject of safeguarding systems for OGP Processes.

This group includes the following standards:

STANDARD CODE	STANDARD TITLE
IPS-E-PR-450	"Process Design of Pressure Relieving Systems Inclusive Safety Relief Valves"
IPS-E-PR-460	"Process Design of Flare & Blow-Down Systems"
IPS-E-PR-470	"Process Design of Emergency Measures"

This Standard Specification covers:

"PROCESS DESIGN OF EMERGENCY MEASURES"

Conceptual design of emergency measures for processing Units in refineries and other chemical plants covers requirements of installation of protective devices such as depressuring valves and equipment isolation valves, tripping factors of Units/equipment and relevant failure actions, etc.

Design of emergency measures is usually supplemented by Licensors' instructions and related regulations and requirements for licensed Units to ensure complete plant protection from emergency situations.

1. SCOPE

This Standard is intended to cover minimum requirements and guidelines for process engineers to specify proper type of emergency measures for probable emergency situations.

Note:

This standard specification is reviewed and updated by the relevant technical committee on June 2002. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 159 on June 2002. These modifications are included in the present issue of IPS.

2. REFERENCES

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

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

No. 30, 1996 Ed., "Flammable and Combustible Liquid code"

API (AMERICAN PETROLEUM INSTITUTE)

API RP 521 "Guide for Pressure-Relieving and Depressuring Systems"

4 th Ed. March 1997

3. DEFINITIONS AND TERMINOLOGY

3.1 Unit or Units

Refer to one or all process, offsite and/or utility Units and facilities as applicable to form a complete operable refinery/ plant.

4. SYMBOLS AND ABBREVIATIONS

APH	Air Preheater
API	American Petroleum Institute
CCR	Central Control Room
DN	Diameter Nominal, in (mm)
FDF	Forced Draft Fan
FO	Failure Open
FSLL	Flow Switch Low Low
HH	High High
HS	Hand Switch
IDF	Induced Draft Fan

LC	Locked Closed
LL	Low Low
LO	Locked Open
NFPA	National Fire Protection Association
PB	Push Button
PDSLL	Pressure Differential Switch Low Low
P&IDs	Piping and Instrument Diagrams
PSHH	Pressure Switch High High
PV	Pressure Valve
S/D	shut Down
TSHH	Temperature Switch High High
TSO	Tight Shut Off

5. UNITS

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

6. DESIGN CRITERIA

6.1 Isolation

The following paragraphs describe the installation standards and design practice for valves used for equipment isolation in emergency cases, including vessels, furnaces and compressors. Installation points of the isolation valves shall be clearly indicated on P&ID, highlighting the distance from the equipment to be protected.

6.1.1 Vessels

6.1.1.1 If the liquid volume in the vessel exceeds 10 m^3 (calculated at normal liquid level with the addition of a tray and reboiler inventory in case of towers, and neglecting line inventory) and one or more of the following conditions exist, emergency isolation valves shall be provided on vessel outlet line below normal operating liquid level.

1) Liquid shall conform to NFPA No. 30,

-Class IA : Liquids shall include those liquids that have flash point below 23°C and boiling point below 38°C.

-Class IB : Liquids shall include those liquids that have flash point below 23°C and boiling point at or above 38°C.

2) Liquids that are heated above their flash point.

3) Temperature is 260°C or higher.

4) Pressure is 1960 kPa(ga) or greater.

6.1.1.2 The valve shall be located no farther than 9 meters measured horizontally from the side of the vessel. The total pipe length from the nozzle to the valve shall not exceed 15 meters.

6.1.1.3 Valves shall be operable from grade or platform as follows:

1) Access to a manually operated valve shall be considered acceptable if the valve can be operated from a platform no more than 6 meters above grade and access to the platform is by

stairway. Access to the platform by ladder is not permitted.

2) Valves having sizes DN 200 (8 inches) and smaller may be manually operated and may be fitted with extension spindles, angle drives and so forth, to fulfill the criteria of operability from grade.

3) Valves having sizes DN 250 (10 inches) and larger shall be electrically or pneumatically operated and controls shall be located in a place at grade safe from the danger of fire.

6.1.1.4 If liquid on a side-draw flows into the bottom of a second vessel, such as a stripper and the total liquid in the draw-off pan plus that in the bottom of the second vessel exceeds 10 m^3 and one or more of the four conditions noted in item 6.1.1.1 above exist, then an emergency isolation valve shall be installed on the bottom outlet line of the second vessel.

6.1.1.5 Where a vessel outlet, within the scope of item 6.1.1.1 above is divided in a manifold system of branches (each with a valve), an emergency isolation block valve is not required if no more than two valves, meeting the requirements of item 6.1.1.3 above, are normally open, an emergency isolation block valve is required upstream of the manifold, if three or more valves are normally open.

6.1.2 Furnaces

6.1.2.1 Fuel lines to process furnaces and steam boilers shall be provided with remotely operated emergency valves. These solenoid operated bubble tight shut off (TSO) valves shall be installed in each main furnace fuel line adjacent to the control valve. Operation shall be remote manual or automatic on closing and manual only opening. Loss of fuel or atomizing steam pressure shall also automatically close these valves.

6.1.2.2 In addition to the above, a manually operated block valve shall be provided in each fuel line. This includes the pilot gas supply line if it is a separate line. These valves shall be located at least 15 meters horizontally from the furnace or boiler being protected. In some instance, a plant battery limit valve may be used to meet the above requirement.

6.1.2.3 Atomizing steam lines to furnaces shall not be cut off automatically but shall be stopped by closing the pressure control valve on this line.

6.1.2.4 Emergency valve on the snuffing steam line shall be located at least 15 meters horizontally from the furnace and operable from grade.

6.1.2.5 Burner isolation valves from the main fuels and steam shall not be located under the heater and shall be arranged to be within arms length of the peep-holes enabling burner flames to be seen.

6.1.2.6 The regulated pilot gas, where possible should be from an independent sweet gas supply or from a separate off-take on the fuel gas main (upstream of main fuel gas control valve) with its own spaded block valve. If continuous pilots are specified, additionally a solenoid operated shut-off valve shall be installed in the pilot gas line operated by emergency shut-down switch only. Low pressure alarm on pilot gas line shall also be fitted.

6.1.3 Compressors

6.1.3.1 Emergency block valves shall be provided in the suction and discharge lines of all compressors having a driver of over 150 kilowatts. When the discharge goes to two different locations, block valves shall be installed on both discharge lines.

6.1.3.2 Compressors under 750 kilowatts may have hand-operated emergency block valves in sizes up to and including DN 200 (8 inches). For larger valve sizes, remote power-operated valves shall be used. If a hand-operated emergency valve is used, it shall be located at least 9 meters horizontally from the compressor. Remotely-operated emergency shutoff valves may be located closer than 9 meters, however the control station shall be installed at least 15 meters from the compressor.

6.1.3.3 Compressors of 750 kilowatts and larger shall have remotely-operated emergency block valves. A control station shall be located in the area of the compressor, at least 15 meters away in a readily accessible location which is not likely to be exposed to fire. A second control station shall be installed in the control room.

6.2 Depressuring

The following paragraphs describe the installation standards and design practice for depressuring valves which are used to protect Units operating at high pressures from an emergency situation by depressuring.

It is understood that the temperature of the system may fall excessively as a result of depressuring, thus requiring checking of other equipment for corresponding temperature and pressure changes and chance of hydrate formation. Also it is conceivable that any sudden opening of the valves may import shock to the flare header, hence this should be checked depending on individual cases. The installation points of these valves should be clearly indicated on the P&IDs.

6.2.1 Design practice

6.2.1.1 Vapor depressuring system shall be installed on equipment if one of the following conditions are encountered.

1) Operating pressure is above 1800 kPa (ga).

2) Process equipment contains more than 2 tonnes of liquid (C4 or more volatile) under normal condition.

6.2.1.2 Depressuring valves shall be located near the equipment to be protected. They shall be operated from the control room or a remote accessible location at grade. The valve, electric motor and the portion of their supply lines located within the fire area shall be fireproofed.

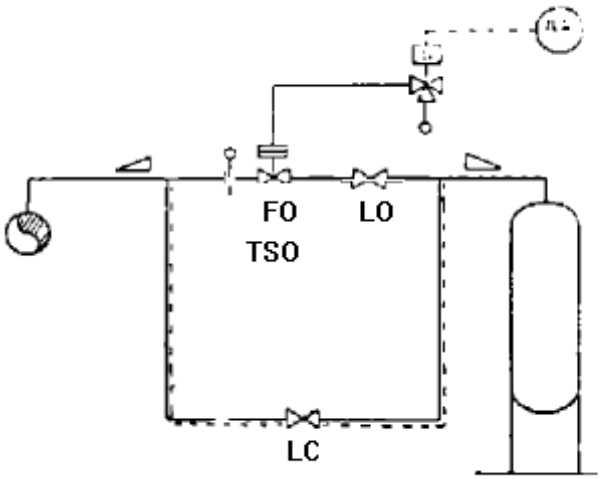
6.2.1.3 The initial pressure is commonly taken as the operating pressure, however the equipment design pressure shall be used as the initial pressure considering operating practices and operator response time. Unless otherwise specified the pressure of the equipment shall be reduced to 50% of the vessel design pressure within 15 minutes while vapor is being generated at a rate corresponding to the following:

1) Vapor generated from liquid by heat input from a fire, plus

2) Density change of the vapor in the equipment during pressure reduction, plus

3) Liquid flashing during pressure reduction.

6.2.1.4 The valves shall be spring-loaded, pneumatic, diaphragm operated without valve positioner and shall have tight shut-off and failure open (FO) functions. The minimum size of the depressuring valves shall be DN 25 (1 inches). They shall not be provided with a handwheel. Locked open (LO) block valves shall be provided to isolate them. Locked closed (LC) bypass valves shall be provided at grade with steam tracing. The arrangement in the vicinity of the depressuring valve (typical) is shown in Fig. 1 below for reference.



TYPICAL ARRANGEMENT IN THE VICINITY OF THE DEPRESSURING VALVE

Fig. 1

6.2.1.5 The method of calculating the total vapor load for a system to be depressured is given in API RP 521 Section 3.19 .

6.3 Trip Sequence

The following paragraphs summarize the tripping factor for Units and equipment and also trip action under the following categories:

1) Furnaces

2) Pumps including hydraulic power recovery turbine

3) Compressors.

The trip sequence shall be summarized on P&IDs. It is necessary however to prepare the sequence logic diagram at the same time. Also it is desirable to explain the outline of trip sequence and shall be explained in the Unit operating manual.

In design of emergency S/D systems, the following features shall be considered:

1) Test of the system should not cause S/D devices to operate.

2) Bypassing of an emergency device in a system shall give a lasting light indication in the control room.

3) "First-out" and fail-safe features shall be provided.

4) All emergency switches shall be secured against accidental activation.

5) The visual alarm shall be used where possible, one working as pre-alarm.

6.3.1 Furnaces

The furnaces shall be provided with a shut down system which shall cut out the fuel oil and fuel gas (including any waste gas to be burnt in furnace such as noncondensible gases) supply to the burners and will be actuated by the following cases:

1) Low low flow of the total feed to the heater or low low flow of passes (two passes per furnace cell, all combined with "AND" logic for furnaces having four passes per cell, implementation of similar requirements for other cases shall be studied separately), with pre-alarm at low flow (for

catalytic reactor heaters Licensor's design practice to be followed).

2) Low low flow of recycle gas (for catalytic reactor heaters), with pre-alarm at low flow.

3) Low low pressure of the pilot gas, with pre-alarm at low pressure.

4) Emergency push button (PB) installed in the central control room.

5) High high pressure of the combustion chamber of the heater, with pre-alarm at high pressure (for heaters for which an air preheating system is foreseen).

6) Low low flow of the combustion air or low low pressure at FDF discharge (or downstream of APH) or FDF failure with pre-alarm.

7) Low low pressure of the fuel gas.

8) Low low pressure of the fuel oil.

9) High high flue gas temperature (upstream and downstream of APH, combined with "OR" logic), if specifically specified by the Company.

10) Low low atomizing steam pressure or low low differential pressure of atomizing steam with regard to fuel oil pressure.

In case of heater shut down, any waste gas fired in the heater shall be diverted to the foreseen alternative destination.

Table 1 shows the summary of the shut down system of furnaces, including the devices to initiate the block sequences and pertinent services of the action devices.

TABLE 1 - SHUT DOWN SYSTEM OF FURNACES

DEVICES TO INITIATE THE BLOCK SEQUENCES									BLOCK AND PERTINENT ACTION DEVICES	
No.	S/D SWITCH	CAUSES	TRIP No.						TRIP No.	SERVICES
			1	2	3	4	5			
1	FSLL	Low low flow of total	×		×	×			1	Close fuel gas to heater
		Feed to the heater or low low flow of passes							2	Close pilot gas to heater
		(Two passes per cell, all combined with "and" logic), excluding catalytic reactor heater							3	Close fuel oil to heater
									4	Close waste gas (off-gas) to heater
									5	Open stack control valve (PV) and open air preheater bypass (if applicable)
2	FSLL	Low low flow of recycle gas (for catalytic reactor heaters)	×		×	×				
3	PSLL	Low low pressure of the pilot gas	×	×	×	×				
4	PB	Emergency manual push button (in CCR)	×	×	×	×				
5	PSHH	High high pressure of the combustion chamber (heater equipped with APH)	×		×	×				
6	FSLL/ PSLL/ FDF FAIL SWITCH	Low low flow of combustion air or low low pressure at FDF discharge (or down-stream of APH) or FDF failure	×		×	×				
7	PSLL	Low low pressure of fuel gas	×			×				
8	PSLL	Low low pressure of fuel oil			×					
9	TSHH	High high fuel gas temperature (upstream/downstream of APH combined with "OR" logic), if specified by Company	×		×	×				
10	PSLL/ PDSLL	Low low automizing steam pressure or low low differential pressure of atomizing steam with regard to fuel oil pressure			×					
11	IDF FAIL SWITCH	IDF failure					×			

6.3.2 Pumps including hydraulic power recovery turbine

The following failure action as shown in Table 2 shall be applied to the main pump of each Unit.

TABLE 2 - SHUT DOWN SYSTEM OF MAIN PUMP OF THE UNIT

ACTION / FAILURE	PUMP S/D SYSTEM	MINIMUM FLOW BYPASS OPEN
Manual shut down	Yes	No
Shut down factors (Note 1)	Yes	No
Process flow low (Note 2)	No	Yes

Notes:

1) Requirements for this failure will be provided by Vendors, typical examples of which are low low lube oil pressure, high high speed of turbine (for turbine driven pumps), high high bearing temperature, etc.

2) This failure applies only to severe turn-down service.

6.3.3 Compressors

The following failure action as shown in Table 3 shall be applied to compressors.

TABLE 3 - SHUT DOWN SYSTEM OF COMPRESSORS

ACTION / FAILURE	COMPRESSOR S/D SYSTEM	MINIMUM FLOW BYPASS OPEN
Manual shut down	Yes	No
Shut down factors (Note 1)	Yes	No
Knock-Out drum level high	Yes	No
Gas flow low	No	Yes (Note 2)

Notes:

1) Requirements for this failure will be provided by Vendor, typical examples of which are low low lube oil/seal oil pressure, high high speed of turbine (for turbine driven compressors), high high bearing temperature, etc.

2) This failure-action applies to the centrifugal compressors only.