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BEST PRACTICIES FOR PRESSURE RELIEF & DISPOSAL SYSTEMS

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

The standard covers relieving devices and their discharge systems of vessels and equipment in the petroleum industry, which are designed for a maximum allowable working pressure of more than 1 Kg/Cm2 g. This standard does not cover the atmospheric and low pressure tanks and pressure vessels used for transportation of petroleum products.

INTRODUCTION

The Pressure Relief and Disposal System is a key safety area in the hydrocarbon processing industries, API- 520 on Design and Installation of Pressure Relieving System in Refineries and API-521, Guide for Pressure - Relieving and Depressurizing Systems are well recognized documents and widely used in the petroleum industry all over the world.

DEFINITIONS

For the purpose of this standard the following definitions shall apply:

i) RELIEF VALVE
Is an automatic pressure-relieving device actuated by the static pressure on upstream of the valve.

ii) MAXIMUM ALLOWABLE WORKING PRESSURE:
It is the maximum gauge pressure permissible at the top of a vessel in its operating position for a designated temperature.

iii) OPERATING PRESSURE:
It is the gauge pressure to which the vessel is usually subjected in service

iv) SET PRESSURE
It is the inlet pressure measured in gauge at which the pressure relief valve is adjusted to open/pop under service conditions.

v) OVER PRESSURE:
It is the gauge pressure on the discharge side of the safety valves.

NEED FOR RELIEVING SYSTEM

The relieving of pressure from a process system arises from a number of reasons as below:

i) This may be required so that a system is not allowed to pressurize beyond its maximum allowable working pressure, in order to avoid possible failure of the weakest part of the system.

ii) For precautionary relieving of pressure from the system called as depressurization. This is applicable for high pressure and or high inventory systems which need to be depressurized during an emergency.

iii) In the case of a fire, the maximum allowable yield stress of the metal reduces significantly due to increased temperature. Relieving pressure under these situations allows the actual stresses to be reduced below the lowered maximum allowable stresses thereby preventing failure.

iv) To take care of thermal expansions when a pipeline or equipment containing a liquid is blocked in and subsequently heated.

PRESSURE RELIEVING / SAFETY DEVICES

There are basically two type of safety devices used for relieving pressure in a system. These are — Safety/Relief valves and Rupture Discs. Safety/Relief Valves may be conventional type, balanced bellow type & pilot operated type.

1. SAFETY/RELIEF VALVES

A. Conventional

Conventional safety/relief valves are susceptible to both superimposed and built-up back pressure and are not recommended when the total back pressure exceeds 10% of the set pressure. For these reactions, these should be used only in system relieving to atmosphere like steam, air or other non-toxic and non-flammable materials.

B. Balanced Bellows

Balanced Bellows valves are not susceptible to back pressure and should be used for back pressure up to 50% of set pressure.

C. Pilot-operated

In pilot-operated safety valves, the main safety valve opens through a pilot valve. Both the pilot and the main valve contain flexible membranes, which can withstand only ordinary service temperatures. Because of this and the risk of fouling, their use is limited to very clean services and are generally not recommended in hydrocarbon services

2. RUPTURE DISCS

Rupture Discs are thin metal diaphragms held between flanges and are designed to bust at the set pressure. Once bust, these are not reusable and have to be replaced. Their set pressure cannot be tested without destroying them. After the test, the rupture disc has to be replaced but there is no guarantee that the second rupture disc will burst at the same pressure. This is a major disadvantage of rupture disc, especially when the bursting pressure is low. For these reasons, rupture discs alone shall not be used. However, they should be used between the vessel and a relief/safety valve for fluid of highly corrosive or fouling nature. Prolonged expose of safety valve directly to such conditions may cause damage to valve components.

3. SET PRESSURE OF RELIEF VALVES

(a) Relief valves should usually be set at 10% higher over the normal operating pressure to allow a reasonable margin so that the valves do not op frequently with minor process upsets. The difference between the set pressure and the normal operating pressure should not be less than 2 Kg/CM2. This is to account for operating contingencies and the fact that spring setting of safety valve at lower pressure is not of high precision. This aspect should be considered for selecting the design pressure (maximum allowable working pressure) of the equipment. The design pressure or maximum allowable working pressure is the highest pressure at which the pressure relief is set to open.

(b) The safety valve set pressure in trunk pipelines should be set within 10% above the maximum allowable operating pressure.

(c) When rupture disc is used, the bursting pressure of the rupture disc should be kept 5% lower than the safety valve set pressure. In order to have a reasonable margin between the bursting pressure and the normal operating pressure, the relief valve set pressure should be 15% higher than the normal operating pressure. A pressure gauge/bleeder between rupture disc and relief valve helps to indicate the health of the rupture disc

INSTALLATION OF SAFETY DEVICES

1. GENERAL

Relieving devices should be installed directly on the equipment they are protecting or immediately adjacent on the connected piping without any valve in the piping. These devices are best installed on the top of vessels or at high points so as to minimize and simplify the inlet piping. Following guidelines shall apply:

(a) Inlet piping shall be adequately sized so as to limit pressure drop between vessel and safety valve to 3% of the set pressure on the inlet side.

(b) The discharge side including the header shall be sized so as to contain total back pressure within permissible limits depending upon the type of safety valve.

(c) Inlet and outlet of a safety valve shall not be less than the nominal sizes of inlet/outlet flanges respectively of the safety valve.

(d) Inlet and outlet (if pressure relieving device is discharging to a closed system) piping shall be free draining away from the safety valve.

(e) The discharge line shall join the header from top and directionally to avoid high pressure drop.

(f) In vessels where there are chances of liquid carryover along with vapor in the form of froth, mist, etc., the inlet line to safety valve and the outlet line from safety valve to the unit knock-out/Blowdown drum shall be sized based on tow-phase flow.