Pressure

Systems

Guidance for the Competent Person in relation to the examination requirements for relief systems

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1. Introduction

The Pressure Systems Safety Regulations (PSSR) 2000 give specific requirements for the design, installation, operation, maintenance and inspection of equipment that may give rise to danger to people from stored energy and the scalding effects of steam due to system failure. This equipment includes pressure vessels, pipework, pipelines and protective devices. However, its relevance to relief systems downstream of the protective device(s) is not clearly defined. This document is intended to clarify the requirements that apply to such systems for both the designer, installer, Competent Person and user.

This guide should be read alongside SAFed guide PEC 13 ‘Guidance for Safety Valve Examination’.

2. Scope

The scope of this document is limited to the application of protective devices within the PSSR, principally safety valves and bursting discs which have pipework and other equipment such as flame arresters, scrubbers, knock-out drums and vent/flare stacks attached downstream to direct the system contents to a safe area. The principles detailed within could also be applied to other systems.

This document does not cover explosion vents or relief systems for deflagration/detonation scenarios

3. Pressure Systems Regulations 2000 (PSSR)

The pressure systems regulations themselves does not specifically delineate relief systems as an individual term for inspection/maintenance, however it does define a ‘protective device’ as below:

“protective devices” means devices designed to protect the pressure system against system failure and devices designed to give warning that system failure might occur, and include bursting discs;

Along with the following information in the ACOP:

18 ‘Protective device’ includes any protective control or measuring equipment which is essential to prevent a dangerous situation from arising. Instrumentation and control equipment would be classed as a protective device in the following situations:

(a) where it has to function correctly to be able to protect the system; and
(b) where it prevents the safe operating limits being exceeded in situations where no other protective device is provided (for example, where the relevant fluid is so toxic that it cannot be released to atmosphere). In these cases the control equipment is itself the protective device.

Protective devices which protect a system which contains or is liable to contain a relevant fluid are covered by the Regulations even if they are located on a part of the system which does not contain a relevant fluid.

Thus, it is important that the safety valve/bursting disc and all parts of the relief system function correctly in order prevent danger.

4. Guidance for the Designer

The legal requirements for the design of pressure systems including relief systems are part of the assessment of the equipment under the Pressure Equipment Safety Regulations (PE(S)R), however it should be noted that the system may be treated as a system installed by the end user and hence the requirements of the PSSR may apply. Whichever route is taken it is the responsibility of the designer to ensure the relief stream is designed correctly for the duty, this will include, but is not limited to, the following considerations:

a) That the system is sized for all reasonably foreseeable relief cases (e.g. loss of process control, runaway reaction).
b) That the system is designed to be capable of withstanding both static and dynamic loads that may be experienced during both normal operation and pressure relief.
c) That the system can be maintained and examined
d) The requirement for instruments such as pressure or level alarms to monitor system condition
e) The requirement for drains to prevent inadvertent liquid accumulation in the system downstream 5.1of the protective devices
f) The materials of construction are suitable for the intended duty
g) The system vents to a safe location

The use of an industry-recognised code for the design of relief systems such as BS EN 764-7, API RP 520, API RP 521, BS EN ISO 4126 or similar is recommended. The chosen code should be consistent with the code used for the system it protects, e.g. BS EN 764-7 should be used on EN-coded vessels.

5. Guidance for the Competent Person

There are many different configurations of relief system however these may be broadly categorised as systems that can be exercised during operation and those which cannot.

In both cases the relief system should be examined at the same time as the out-of-service examination of the protected equipment and of the protective device itself as a minimum. This examination should cover as a minimum:

- The inlet and discharge piping of the protective device for obstruction
- The discharge pipework is adequately supported see picture below
- Any drains to prevent liquid accumulation are clear
- The condition of the inlet and discharge piping, externally
- The outlet vent discharges to a safe location

The discharge pipe is plugged!

Why? Because when the valve lifts it unscrews itself from the equipment! (Due to the reaction force and no restraint on the pipework)

For complex relief systems (e.g. multiple devices relieving into a relief header) it may not be possible to examine the entire system at the time the protected equipment is inspected. If this is the case, then the entire relief system should be scheduled for periodic examination at a suitable interval. These cases tend to occur on process plant which are subject to routine turnarounds.

5.1 Systems where the protective device can be exercised in operating conditions

Where the configuration of the system permits in-service functional testing of the protective devices (e.g. steam boilers), testing may be carried out as part of the Regulation 9 Examination. On a clean process duty, this examination proves that the relief stream is clear, and no further action may be needed. The Competent Person should record that this is the case on his report for the pressure equipment in question.

The use of devices to mechanically assist the safety valve lifting such as "Trevitesting" is also acceptable, provided that the other remaining parts of the relief system are also proven clear.

5.2 Systems where the protective device cannot be exercised under operating conditions.

Where the relief stream cannot be proved in service, i.e. where it is undesirable for the contents to be freely vented then these systems need an approach which reflects the role of the Competent Person in the process.

5.2.1 Some relief systems are short, easily accessed by the Competent Person and can be checked as clear as part of the examination of the equipment. The engineer surveyor should indicate on his report that he has confirmed by visual means that the relief stream is clear.

5.2.2 Most relief systems are more complex than those described in 5.2.1, and as such it is not practical for the Competent Person to confirm that these systems are free from obstruction that would affect the operation of the protective device. In situations such as this the Competent Person should note the condition of the relief system as found and identify keeping the relief system clear and operable as a specific maintenance task on his report. The Competent Person may wish to review relief system maintenance records at the time the examination is carried out. As described above the extent of inspection is dependent on the likelihood of the system to fouling.

5.3 Protective devices where no relief stream/pipework is fitted.

Certain pressure system protective devices have no relief systems, such as compressed air etc. As a good practice it should be noted on the PSSR report for the protective device that no relief stream pipework is fitted and that any transit dust caps are removed.

6.0 Guidance for the User.

While this guidance is aimed at the inspections carried out by the Competent Person under the requirements of Regulation 9 of PSSR, the user plays a pivotal role in the correct function of protective devices and relief system, specifically that such systems should be maintained fully in accordance with PSSR Regulation 12 - Maintenance.

It is the User's responsibility to ensure that relief systems function correctly at all times that the equipment it protects is in operation. The relief systems must therefore be maintained properly by the user, including the requirement for it to be kept clear of obstructions and debris that may affect the operation of the protective device.

It is recommended that an assessment is carried out to establish the maintenance type and frequency to ensure satisfactory operation of the relief system.

The maintenance regime may entail some of the following activities:

a) Visual inspections
b) Draining of low points
c) Trip and alarm testing of relief system instrumentation
d) Rodding, flushing or jetting of pipe bores, using flexibles etc.
e) Ultrasonic or acoustic ranging techniques
f) Air flow techniques.

In the event that pressure relief does occur, additional maintenance may be necessary to restore the relief system back to its original state (e.g. removal of process fluids, replacement of components).

Whilst PSSR does not require records of such maintenance to be kept by the user it is considered good practice to keep adequate records. The Competent Person may wish to review such User maintenance records as evidence that the relief system will function as intended. If a relief event has occurred between inspections the User is encouraged to provide such process records to the Competent Person as additional work may be needed at the time of the examination.

7.0 Modifications to Relief systems

The design of relief systems are an integral part of the safety system, and as such should be subject to similar requirements, ACOP (174) to Regulation 13 - Modification and repair, of the PSSR which states that:

174 When designing any modifications (including extensions or additions) or repairs to the pressurised parts of the system, whether temporary or permanent, the following should be taken into account:

(a) the original design specification;

(b) Etc……

Hence if they are modified, they should be,

a) Carried out by people competent to do so.
b) All aspects of their operation/maintenance, inspection etc. should be considered by the designer/user.
c) Adequate calculations carried out to show that the capacity of the system is maintained.
d) Adequate records in accordance with Regulation 14 - Keeping of records etc., should be kept by the user.
e) The Competent Person should be advised.

8.0 References

PE(S)R – Pressure Equipment (Safety) Regulations 2016

PSSR – Pressure System Safety Regulations 2000

BS EN 764-7 - Pressure equipment. Safety systems for unfired pressure vessels

BS EN ISO 4126 - Safety devices for protection against excessive pressure

API RP 520 - Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries

API RP 521 - Guide for Pressure-Relieving and De-pressuring Systems

PEC-13 - Guidance – Safety Valve Examination – Setting and Sizing requirements

Appendix A - Suggested Techniques for Examination of Relief Systems

There are a number of different techniques that can be used to prove that a relief system is clear. This may be carried out by specialist contractors. The service, length and complexity of the system will determine which method to use. It may be necessary to use more than one method.

- Visual examination. Sections of the system may need to be dismantled in order to cover the full system and examine it visually
- Live testing via operation of the relief valve or blowing down the system. The advantage is that the system can be proof tested under controlled conditions. This may only be possible for fluids that have negligible environmental impact such as steam, however. As well as witnessing the process fluid leaving the vent, the system pressure should also be monitored to ensure the total accumulation pressure does not exceed code.
- Acoustic ranging – this involves sending a burst of sound down a piping system. Any obstructions will cause a reflection to occur which can be picked up with transducers. The equipment can give an indication of the distance of the reflection from the instrument.
- Flushing with water – this involves flushing through the system with a hose. There needs to be high enough flow rate to prove the system clear. Low flow rates may be insufficient to prove a system clear.
- Camera – drain cameras can be used to visually examine systems. It's possible to examine straight lengths of around 50m or more. More sophisticated motorised camera systems are also available.
- Rodding – short lengths of the system can be proven clear by rodding.
- Drone – Large diameter systems such as stacks can be examined internally using drones. Specialist drones are available that work well in confined spaces.
- Radiography – It is possible to use radiography to examine small sections of line if the blockages are severe enough.