

*Please note that as at 27 Nov 07 this is a archive link as the original HSE one is "broken", however the document is still referred to in the HSE " Guidance for the topic assessment of the major accident aspects of safety cases" (See link at <http://www.hse.gov.uk/offshore/gascet/gascet.pdf> )*

*Readers of this Safety Notice must take this into account and contact the HSE for the latest issue.*

## Balanced bellows pressure relief valves - problems arising from modification of the bonnet vent

- **Safety notice:** 2/2002
- **Issue date:** May 2002

### Introduction

1. This notice highlights potential problems that may arise as a consequence of modification to bonnet vents of balanced bellows type pressure relief valves. Pressure relief valves are provided on process systems to prevent rupture of pressure vessels and leakage of pipework flanges under applied pressure arising from faults in the process control system or short term uncontrolled heat input. They are used in conjunction with other protective systems. An impaired pressure relief valve on an offshore installation may fail to prevent an explosion, a sudden large toxic gas release or rapid escalation of fire.

### Background

2. Some installation operators have experienced a number of failures of bellows in balanced bellows type relief valves. A bellows failure provides a route for the release of process fluids to the atmosphere via the pressure relief valve bonnet vent. When the relief valve experiences over-pressure the valve disc will lift to allow process fluid to discharge into the outlet of the valve. The fluid can then reach the bonnet vent via any holes in the damaged bellows. It is also quite usual for pressure relief valves, blowdown valves and pressure control valves to share a common vent system at their outlets. Any backpressure built up in a common vent system may result in a backflow of process fluids to the outlet of the pressure relief valve with damaged bellows. This may also result in a release of process fluids to the damaged relief valve's bonnet vent. This is a potentially hazardous situation since many process fluids are flammable and/or toxic. As a result some installation operators have modified the bonnet vents of balanced bellows pressure relief valves to prevent this risk. However, such modifications may adversely affect the valve's performance both in normal operation, and on failure of the bellows.
3. The most common modification involves plugging the bonnet vent. This is against the recommendations of the Code of Practice API RP 520, and will result in impairment of the valve's performance. The pressure increase over the maximum allowable working pressure of the protected process system (accumulation) may exceed that allowed by the relevant pressure vessel codes. The installation of a plug prevents detection of a failed bellows.
4. Another form of modification is the installation of a telltale in the bonnet vent. The telltale is a shuttle that normally allows the bonnet of a balanced bellows pressure relief

- valve (with intact bellows) to vent locally to atmosphere on a demand for the pressure relief valve to open. This action does not impair the normal operation of the balanced bellows pressure relief valve and does not result in a local vent of toxic or flammable hydrocarbons. However, in the event of failure of the bellows the shuttle is displaced so as to block the bonnet vent. Blockage of the vent will then impair the performance of the pressure relief valve as described for the plug above, although significantly reducing the amount of toxic or flammable gas released local to the valve. The main advantage of the telltale over the plug is that monitoring of the telltale post-pressure relief will indicate bellows failure.
5. Adopting the above measures while tackling local toxic and flammable hydrocarbon releases diverts attention away from, and obscures the underlying causes of, the potentially more significant failure of the bellows. When the pressure relief valve (with the failed bellows) is required to open, potentially critical overpressure may occur. This is due to the pressure relief valve starting to open at a pressure above the required set pressure, and also to limitations in flow capacity arising from a decrease in lift of the valve disc from the valve seat. The force applied to the valve disc by the back pressure from the vent or flare system transmitted via the burst bellows can cause either of the above symptoms.

## Action required

6. The following actions must be taken:

### **(a) Immediate**

Installation operators must survey all balanced bellows pressure relief valves in service on their installations to ascertain the mode of bonnet venting. Where plugs or telltales are in place, the consequences of the blocked bonnet vent on relief valve performance must be established. Where vessel code over-protection requirements are not met due to a blocked bonnet vent affecting the balanced bellows pressure relief valve, the plug or telltale must be removed. This must be done safely. Plug or telltale removal may introduce the risk of local venting of flammable or toxic gas. Where risk assessment shows immediate removal of the plug or telltale to be unsafe, the affected system must be taken out of service immediately, unless adequate alternative over-pressure protection is available.

### **(b) Longer term**

Where failure of bellows has resulted in the application of plugs or telltales to bonnet vents, the following aspects must be reviewed and remedial measures implemented:

- i. The root cause of bellows failure should be investigated with the bellows and valve manufacturer (chattering, incorrect material specification, incorrect pressure rating, incorrect installation, incorrectly specified fatigue life, incorrect dimensional tolerances on bellows manufacture etc) to eliminate bellows failure so far as is reasonably practicable.
- ii. If local release of toxic or flammable hydrocarbons cannot be tolerated then bonnet vents should be piped to a safe location as recommended by API RP 520.
- iii. If bellows failure cannot be eliminated (in circumstances when valve performance is impaired) then different pressure relief valve types should be provided.

## Relevant legal requirements

7. The main relevant legal requirements are:

- Health and Safety at Work etc Act 1974
- The Provision and Use of Work Equipment Regulations 1998 (SI 1998/2306) (PUWER)
- The Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995 (SI 1995/743) (PFEER)

## References

**Sizing, selection, and installation of pressure - Relieving devices in refineries, Parts I and II**  
API Recommended Practice 520 American Petroleum Institute 2000, 1994

**Guidelines for the safe and optimum design of hydrocarbon pressure relief and blowdown systems**  
Petroleum Institute 2001 ISBN 0 85293 287 1

## Further information

8. Any queries relating to this notice should be addressed to:

*Health and Safety Executive  
Hazardous Installations Directorate  
Offshore Division  
Lord Cullen House  
Fraser Place  
Aberdeen  
AB25 3UB*

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This practice has been brought to the attention of the Health and Safety Executive's Hazardous Installations Directorate's Refinery Issues Group.

This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.