Overpressure protection to the low pressure system

Technical facts:

A pressure regulator is a mechanical component controlling the downstream pressure by a spring loaded membrane moving the regulating valve in dependence of the necessary gas flow of the downstream gas consuming device. The membrane and valve is continuously exposed to movement and abrasion. Thus a pressure regulator membrane is a consumable part that needs often repair and is sensitive for failures.

In case of a break of the membrane and depending of the design and construction of the regulator the upstream pressure might no longer be reduced. As consequence the downstream parts are exposed to the upstream pressure. For this kind of failure measures must be provided to avoid damage of the downstream parts, e.g. pressure relief devices or pressure sensor combined with shut off-function of the high pressure source, or design and construction of the downstream parts for the upstream pressures.

General comment:

While up to now European and Japanese regulations are safety oriented and stipulate preventative measures the GTR proposal omits such measures (e.g. overpressure protection, air tightness tests, strength tests, material or strength requirements etc.) and focuses on the limitation of the consequences of a failure. This is a break in the safety targets of the new regulations and cannot lead into an equal level of safety as provided by the already enforced ECE-regulations (CNG, LPG) and EC-regulation 2009/79/EC as well as the ECE-drafts for hydrogen vehicles which are mandatory in Germany. In our opinion it is indispensable to avoid a malfunction by preventative performance requirements. The limitation of consequences by detection and shut off of the system is an additional necessity not a substitute.

Comment to the GTR-/OICA-proposal

With the safety measures for the downstream system the GTR/OICA-proposal only covers the risk of leakage. In our opinion also the risk of burst and related mechanical damage or injury caused by debris or high pressure gas streams shall be covered. Such burst can occur if the downstream system designed for low pressure is subjected to high pressure (up to 70 MPa) caused by a malfunction of the pressure regulator as described above. might

This is especially important with regards to manufacturers as well as inspection parties who do not have enough experience in pressure technology e.g. small series manufacturers (who by the way are not organised in OICA and thus have no representative in the working groups).

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Technical Rationale for Overpressurization

Other regulations codes and standards (RCS)

Pressure technology related regulations know the failure of the pressure regulator and require measures to avoid accidents resulting from this kind of failure.

Thus this requirement is state of the art and the glance into the regulations, codes and standards proves that there must be a considerable probability for this kind of failure.

Examples of RCS with requirements for protection against overpressure

- ECE R 110, 17.3.2.2. in connection with 17.1.1,
- ECE R 67, 17.3.2.3 in connection with 17.1.1,
- ECE-draft for LH2, 6.3.2, ECE-draft for CGH2, 4.1.18,
- Japan 100 3-4-1
- implementing measures for EC-regulation 2009/79EC, appendix 3, 2,3;
- NGV3.1, 1.9,
- European Pressure Equipment Directive 97/23EC, Annex I, 2.10, ...)
  ...

Risk consideration

Most important of all is the regard of the consequences of a failure.

Despite that the severe consequences of such failure with resulting burst shall take precedence in a safety oriented view:

- In case of a burst in the downstream system there is a high risk and high probability of severe or even fatal injuries of persons near the vehicle. In case of maintenance or repair workers who often work under the vehicle or with open hoods are particularly endangered.
- Secondary damages in the gas system or other parts of the vehicle might occur that result in severe consequences.
- In case of a burst there will be high amount of Hydrogen set free in a short time – in the worst case the pressure is 70MPa. The explosion hazard is high as it is hardly imaginable that there is no source of ignition in such a case. The detection system required by OICA-proposal might not be fast enough to avoid inacceptable risks.