API 521 9th Edition Ballot

Liquid Displacement Piping Considerations (Work Item 28)

Instructions to Voters/Commenters

- Please limit your comments to the red- or blue- lined portions of the ballot only. Note that red indicates modifications to the existing wording, whereas blue indicates new text.
- If you are voting negative with multiple comments, please indicate which comment(s) is the reason for your negative vote, otherwise API's balloting system will categorize all of your comments as negative.
- Note that this ballot is intended for publication in the 9th Edition. However, if the ballot is approved and closed prior to the publication of the 8th Edition, it will be included there.

Thanks to James Dean and the work group for their efforts.

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API 521 Task Force Chairs

API STD 521 9th Edition Proposed Language for Ballot

3.1.41 Liquid Displacement

A phenomenon where a vapor or less dense fluid enters a system, displacing the existing liquid and forcing it downstream (often through the relief system) at an equivalent volumetric flow rate.

4.4.17 Piping Design Considerations

Certain scenarios such as inadvertent valve opening (see 4.4.9.2) and vapor breakthrough (see 4.4.8.3 and 4.4.8.7) can result in slug flow, liquid displacement, and/or high flow velocities in the piping between the locations of vapor breakthrough or inadvertent valve opening and the inlet to the PRD (see Annex G). The ~~resultant~~ resulting pressure changes and hydraulic losses through process piping as well as the dynamic (transient) loads on the process and PRD inlet piping should be taken into account, including the mechanical design and pipe supports.

Annex G
(informative)

Vapor Breakthrough into Liquid-containing Systems

Failure of high-pressure vessel liquid bottoms level control and/or bypass valves discharging into a low-pressure system may result in a significant increase in the low-pressure system liquid level. Depending on the high-pressure and low-pressure system volumes, liquid inventories and liquid properties, the low-pressure downstream system may overfill with liquid.

Of special concern, in certain cases this scenario may be followed by loss of liquid level in the high-pressure system that can result in vapor breakthrough across the level control and/or bypass valves to the low-pressure systems (the scenario described in 4.4.8.3). As the vapor passes through the level control valve, the vapor will expand and push (displace) the liquid in the downstream system until a relief path is established. This transient scenario is commonly described as liquid displacement.

The expanding vapor in a vapor breakthrough scenario can result in rapid pressure increase and high flow velocities in the piping between the locations of vapor breakthrough and the PRD (see 4.4.17). The

resulting pressure drop on process piping and vessels as well as the transient loads on the process and PRD inlet piping should be taken into account, including the mechanical design and pipe supports.
During the scenario, the liquid level in the low-pressure vessel can rise creating the potential for liquid or two-phase relief. This can result in increased low-pressure system relief requirements relative to a vapor breakthrough with only vapor relief. The consequences of liquid displacement are sensitive to the size of the low-pressure system and liquid inventories in the high and low-pressure systems prior to the start of the scenario. Hence, a review should be undertaken to identify the worst-case conditions (e.g. combined liquid inventories and system pressures) for the liquid displacement assessment considering all equipment operations/status.

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Note that the rest of Annex G remains unchanged.