

Agenda Item 620-1031

Title: Resistance to sliding requirements in API 620 L.3.3.3, L.4.3.10 and L.4.4.4

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Revision: 1

Handled By:

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Purpose: Ensure that API 620 Sections L.4.3.10, L.4.4.4 are aligned with the intent of Section L.3.3.3

Source: "Suggestion for Change"

Impact: Neutral

Rationale:

As per Section L.3.3.3 the resistance to shear forces shall be provided by friction only. Furthermore, sections L.4.3.10 and L.4.4.4 explicitly state that "anchorage may not be used to resist sliding". However, the term "may" could be interpreted as indicated it is not a mandatory requirement. To ensure clarity, it is proposed to replace "may" with "shall".

In high seismic regions, reconfiguring the tank often proves impractical due to large tank diameter requirement. Section 6.6.9 of API 625 (Ed. 1, Add-4 (2021)) offers alternative analysis options, including time history analysis for determination of sliding resistance. Therefore, it is proposed to allow the alternative methods to align with the provisions outlined in API 625.

Excerpts from API 620

L.3.3.3 Resistance to Sliding

The tank system, whether self-anchored or mechanically-anchored, shall be configured such that the overall horizontal shear force at the base of the tank does not exceed the friction capacity as defined in L.4.

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L.4.3 Operating Level Earthquake (OLE)

L.4.3.10 Sliding Resistance

The calculated sliding force at the base of the tank shall not exceed V_s (API 650, E.7.6) (A_i and A_c are defined in L.4.3.2). The maximum coefficient of friction, μ , shall be $(\tan 30^\circ/1.5)$ where 1.5 is the factor of safety against sliding. The coefficient of friction selected shall consider the materials underlying the tank bottom. Anchorage may not be used to resist sliding. If the sliding force exceeds the allowable, the tank shall be re-configured.

L.4.4 Contingency Level Earthquake (CLE)

L.4.4.4 Sliding Resistance

The calculated sliding force at the base of the tank shall not exceed V_s (API 650, E.7.6) (A_i and A_c are defined in L.4.4.2). The maximum coefficient of friction, μ , shall be $\tan 30^\circ$. The coefficient of friction selected shall consider the materials underlying the tank bottom. Anchorage may not be used to resist sliding. If the sliding force exceeds the allowable, the tank shall be reconfigured.

6.6.9 Resistance to Base Shear—Sliding

- 18 | The rules in API 620, Annex L shall be applied to determine sliding resistance. In high seismic regions a more extensive analysis may be applied, provided it includes evaluation of the response of the shell, the fluid, and foundation (in the case of a slab) to the fluctuation of liquid pressures in the tank. When applying this approach, the horizontal and vertical seismic response shall be applied based on the component combination of 100 % and 40 %. The case for the 100 % vertical plus 40 % horizontal load case shall be evaluated in addition to the 100 % horizontal plus 40 % vertical load case defined by API 620, Annex L. Alternately, a time history analysis approach may be applied incorporating both horizontal and vertical motions simultaneously. | 18

Proposed Changes in API 620 Annex L

L.4.3.10 Sliding Resistance

The calculated sliding force at the base of the tank shall not exceed V_s (API 650, E.7.6) (A_i and A_c are defined in L.4.3.2). The maximum coefficient of friction, μ , shall be $(\tan 30^\circ/1.5)$ where 1.5 is the factor of safety against sliding. The coefficient of friction selected shall consider the materials underlying the tank bottom. Anchorage ~~may shall~~ not be used to resist sliding. If the sliding force exceeds the allowable, the tank shall be re-configured. ~~In high seismic regions, alternative analysis approaches prescribed in Section 6.6.9 of API 625 may be applied to determine sliding resistance.~~ a more extensive analysis may be applied, provided it includes evaluation of the response of the shell, the fluid, and foundation (in the case of a slab) to the fluctuation of liquid pressures in the tank. When performing a time history analysis, both horizontal and vertical motions shall be applied simultaneously.

L.4.4.4 Sliding Resistance

The calculated sliding force at the base of the tank shall not exceed V_s (API 650, E.7.6) (A_i and A_c are defined in L.4.4.2). The maximum coefficient of friction, μ shall be $\tan 30^\circ$. The coefficient of friction selected shall consider the materials underlying the tank bottom. Anchorage ~~may shall~~ not be used to resist sliding. If the sliding force exceeds the allowable, the tank shall be reconfigured.4 Contingency Level Earthquake (CLE). ~~In high seismic regions, alternative analysis approaches prescribed in Section 6.6.9 of API 625 may be applied to determine sliding resistance.~~ a more extensive analysis may be applied, provided it includes evaluation of the response of the shell, the fluid, and foundation (in the case of a slab) to the fluctuation of liquid pressures in the tank. When performing a time history analysis, both horizontal and vertical motions shall be applied simultaneously.