Internal Corrosion in Pipeline Facilities

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1 Introduction

In January 2022, API published Recommended Practice 1188, *Hazardous Liquid Pipeline Facilities Integrity Management*, 1st Edition [1]. Internal corrosion is one of the primary threats identified in API RP 1188 as having the potential to impact onshore hazardous liquids pipeline facility integrity. Due to the increased prevalence of internal corrosion within facilities (relative to internal corrosion in transmission pipelines) and the challenges in performing facility piping inspections because the majority of the piping is unpiggable, this technical report provides an overview of internal corrosion threats within facilities and guidance on threat management and mitigation. A few case studies are provided to showcase where internal corrosion failures within facilities have occurred; lessons learned from those incidents; and how operators are evaluating and addressing the threat.

2 Background Information

The 2016 API Pipeline Performance Tracking System (PPTS) advisory *Operator Advisory on Facilities Piping and Equipment* indicated that most releases that occur at pipeline facilities are small (i.e., ≤ 5 BBLs) [2]. This trend is true both for facilities incidents overall and failures specifically related to internal corrosion. API data from 2010 to 2021 indicate that over half of the internal corrosion failures have been ≤ 5 BBLs [3].

There is no discernable trend in the number of internal corrosion failures from 2010 to 2021. There was an increasing trend through 2015, with the trend decreasing slightly over the next few years, followed by a minor increasing trend for a few years. The lack of trending is likely due to a combination of improved corrosion control/management measures and increased emphasis on internal corrosion as a primary threat within facility piping in the past decade, being counteracted by the progression of corrosion within aging facilities (since corrosion is a time-dependent threat).

According to the 2016 PPTS Advisory, at least 50 % of facility releases caused by internal corrosion occurred at a low point in the facility pipe. This trend has continued, with 73 % of internal corrosion incidents from 2010 to 2021 being identified as occurring in low points.

Between 2010 and 2021, there was a significantly larger percentage of internal corrosion related failures on large diameter piping within facilities (i.e. ≥ 24 in.) than external corrosion failures on large diameter piping. During that period, 8 % of the external corrosion failures were on piping ≥ 24 in., compared with 24 % of internal corrosion failures on piping ≥ 24 in. In comparison, 29 % of external corrosion failures were on piping < 8 in. in diameter, whereas 11 % of internal corrosion failures were on piping < 8 in. in diameter. While the total distance of facility piping of each diameter is not known, the fact that there is a higher percentage of failures caused by internal corrosion on large diameter versus smaller diameter could indicate that diameter plays a role in the potential for internal corrosion to occur within facilities. This is likely related to the impact of diameter on flow velocity and thus the decreased ability to entrain or sweep water and solids with increasing pipe diameter.

API data [3] indicate that for 38 % of internal corrosion failures, visual inspection results showed localized pitting (versus general corrosion). The predominance of localized corrosion is not surprising, given that most internal corrosion mechanisms manifest as localized versus general corrosion. By cause, 47 % of internal corrosion was attributed to microbiologically influenced corrosion (MIC); 37 % to water dropout/acid; 7 % to corrosive commodity; and 1 % to erosion. The remaining was attributed to "other."

As shown in Figure 1, a review of internal corrosion failures that occurred between 2010 and 2021 relative to the decade of installation shows that of known pipe installation years, pipe installed in the 2010s had the highest number of failures, with almost 40 % more than the next highest category (44 versus 32). This suggests that:

1) internal corrosion is not being adequately addressed as new piping or facilities are being installed;

2) internal corrosion failures within facilities can occur at locations where high corrosion rates exist; or