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Addendum 1

Part 2 – Probability of Failure Methodology

Section 3.4.2 b), shall be updated to:

Governing Thinning DF, $D_{\text{f-gov}}^{\text{thin}}$ —The governing thinning DF is determined based on the presence of an internal liner using Equation (2.4).

Section 4.5.7 c) 1), the last sentence shall be updated to:

If no measured thickness is available, set $t_{\text{rdi}} = t$ and $age_{\text{tk}} = age$ from Step 1.

Section 2.C.5.2, the last sentence of the 1st paragraph shall be deleted.

Part 3 – Consequence of Failure Methodology

Section 5.8.5.5 b), 2nd paragraph, last sentence shall be updated to:

The heat of combustion of TNT, HC_{TNT}, is approximately 2000 Btu/lb (4648 kJ/kg).

Part 5 – Special Equipment

The Title of Section 3 shall be updated to:

3 Pressure Vessels

The following will be added as Section 8:

8 Piping

8.1 Piping Modeling Considerations

Several RBI component groupings or circuits may be used when modeling piping:

a) Line Number – Defining piping components by line number is the most detailed level of analysis. An advantage of this approach is improved precision of risk calculations for each component. In addition, defining required inspection to mitigate risk and assigning inspection credits is straightforward. Challenges with this approach are:
   1) Allowing extra time required to organize and maintain the data.
   2) Determining the method for assigning a risk value to represent the piping asset.
   3) Defining inventory calculation method to realistically assess COF.
   4) Defining the method for assigning POF for each piping asset.

b) Diameter Groupings – The component diameter impacts the risk in both the POF and COF calculations. Increasing the diameter increases the inventory available for release as well as potentially increasing the inventory release rate and mass. As pipe diameter decreases, the nominal wall thickness decreases and results in higher POF at the same corrosion rate applied to all components. An advantage of this approach is less time required to organize and maintain data while providing more precision and relative risk calculations. Challenges with this approach are:
    1) Diameter groupings are generally not one continuous component but represent several pipe segments in the piping asset.
    2) Consistent methods for assigning the risk value used in risk prioritization.
    3) A method for modeling inventory for COF calculations is required.
    4) Ages of piping sections and inspections.
c) Predominant Diameter – Using the predominant diameter in risk determinations and prioritization is the least detailed approach. The advantage of this method is that less time is required to organize and manage data. In addition, COF calculations are simplified, and each piping asset is modeled as one component. Challenges of this approach are:
    1) More conservative COF but less conservative POF, resulting in less precise risk values.
    2) Assessing inspection history available for POF determination.
    3) Assigning inspection credits for piping components for other pipe diameters.
    4) Highest risk/POF diameter should be broken into separate components.

8.2 Assigning Risk by Piping Asset

When risk is defined using the line number or diameter grouping approaches, a method for representing risk for each piping asset is recommended. There are several commonly used approaches for assigning risk to piping assets:

- Highest risk component – Assigning the maximum risk piping component to represent the piping asset risk is conservative and may underestimate loss of containment for high POF components.
- Combine highest POF and COF – Assigning the risk using the highest piping component POF and highest piping COF is conservative and leads to over-inspection.
- Highest POF component – Assigning the risk from the highest POF piping component is usually conservative but may underestimate high-risk components with moderately high POF and COF.
- Risk using system level POF – Assigning risk using a system-level product of the individual component POF.

8.3 POF

8.3.1 General

The procedures for component-level POF calculations are provided in Part 2. The POF as a function of time and inspection effectiveness is determined using a GFF, a management systems factor, and DFs for the applicable active damage mechanisms, as described in Section 4.1.

8.3.2 Calculating Component POF

Guidance for calculating component POF is provided in Part 2, Section 3.1, Equation (2.1). The calculation of system-level POF is provided in Equation (8.1).

$$P_f(t) = 1 - \prod_{n=1}^{N} \left(1 - P_{f,n}(t)\right) \tag{8.1}$$

System-level POF is calculated with the product of the individual component POF for the piping asset.

8.4 COF

8.4.1 General

COF calculation procedures for two levels of consequence analysis are provided in Part 3, as described in Section 4.2. In both methods, the consequence analysis may be determined in consequence area or in financial consequence. Consequences from flammable and explosive events, toxic releases, and nonflammable and non-toxic events are considered based on the process fluid and operating conditions.

8.4.2 Inventory Calculation Considerations

It is expected that the inventory from the piping connecting one pressure vessel (piping asset) to another would be potentially available for release in the event of a breach of containment. Using a line number or diameter grouping approach for piping risk may result in underestimating the inventory available for release since components are defined by short sections of piping in the overall piping asset. The recommended method of defining piping component inventory mass is to assign the component mass as the mass of the piping asset to more conservatively estimate COF.

Guidance for calculating the maximum inventory mass available for release is provided in Part 3, Section 4.4. Component mass inventory is described in Section 4.4.2.b. Component inventory mass for piping, $mass_{comp}$ should be calculated using the piping asset data for each piping component, as applicable.

8.5 Risk Analysis

Risk as a function of time is calculated per Section 4.3.1. The distribution of risks for different components may be plotted on a risk matrix or iso-risk plot, as described in Section 4.3.2.2 and Section 4.3.2.3, respectively. Risk is calculated using results from the POF and COF calculations in Section 4.3 and Section 4.4.

8.6 Inspection Planning Based on Risk Analysis

The procedure to determine an inspection plan is provided in Part 4. This procedure may be used to determine both the time and type of inspection to be performed based on the process fluid and design conditions, component type and materials of construction, and the active damage mechanisms.